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Regular Research Article

Learning from past pandemic governance: Early response and Public-Private Partnerships in testing of COVID-19 in South Korea

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ABSTRACT

How can political elites learn from the past to enhance sustainability of their leadership in a pandemic situation? In this article, we develop a theoretical framework of policy implementation that combines collaboration from public and private sectors ("Public-Private Partnership," or PPP) to efficiently deal with urgent crises such as COVID-19. We explain the role of new institutions prompted by policy failure precedence (Time 1) that at a later time period (Time 2) allow for the activation of PPPs with the aim to extend the political life of incumbent leaderships. Specifically, we examine the case of South Korea, a country in which a prior case of MERS in 2015 (Time 1) had established new policies for pandemic governance. In 2020, such policies were activated by the incumbent leadership in order to contain COVID-19 (Time 2). In particular, for swift and effective management of the pandemic, the South Korean government utilized partnerships with the private sector to exponentially increase the amount of Real-Time Polymerase Chain Reaction (RT-PCR) testing. We apply Policy Feedback Theory to demonstrate the political effects of failed policy precedents and how the political outcomes again shape new policies in a dynamic and cyclical manner. Empirically, we conduct a content analysis of South Korea's pharmaceutical sector in government procurement and exports of test-kits during the COVID-19 pandemic. We show that as the pandemic situation progressed, South Korea's leader, who had been in danger of plummeting support to the extent that impeachment was discussed as a viable option, drastically shifted public opinion to achieve a landslide victory in general elections in April 2020. Our findings suggest that democratic governments, aware of precedents and wary of their fate in elections, are pressured to perform well in crisis management, and thus turn to rapidly mobilizing public and private means for survival. Such means are evidenced by the case of emergency use authorization (EUA) process for test-kits, in which "leapfrogging players" – up-and-coming innovators – that contribute to turning a pandemic crisis into an opportunity for sustainable leadership and for themselves.

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1. Introduction

How do political elites learn from the past to enhance sustainability of their leadership in a pandemic situation? We examine the case of South Korea, where policy failure precedence during a case of Middle East Respiratory Syndrome (MERS) in 2015 established new policies and brought about institutional changes in combatting future infectious diseases. Such policy moves paved the way for early response and governance of the novel Coronavirus outbreak of 2019 (COVID-19) upon its spread in South Korea in 2020, allowing for swift and efficient containment of the virus

via Public-Private Partnership (PPP) on Emergency Use Activation (EUA) of Real-Time Polymerase Chain Reaction (RT-PCR) test-kits developed by "leapfrogging" innovators of the South Korean In Vitro Diagnostics (IVD) industry for large-scale testing of COVID-19 under the Infectious Diseases Prevention and Control Act (IDPCA). Consequently, the effectiveness of the response by the Korea Centers for Disease Control (KCDC)¹ led to an extension of the political life of the incumbent Moon Jae-in administration, drastically shifting negative public opinion toward a landslide victory in general elections in April 2020.

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E-mail addresses: jpark12@gwu.edu (J. Park), eunbin.chung@poli-sci.utah.edu (E. Chung).¹ As of September 12, 2020, the KCDC has been elevated and renamed as the Korea Disease Control and Prevention Agency (KDCA). Based on the timeline of this research prior to the elevation, this article uses the former acronym, KCDC.

We develop a theoretical framework of policy implementation that combines a) policy feedback theory, to demonstrate the political effects of failed policy precedents and how the political outcomes again shape new policies in a dynamic and cyclical manner; and b) PPP, to examine how public and private sectors collaborated to control COVID-19. Our findings suggest that democratic governments, aware of precedents and mindful of elections, are pressured to perform well in crisis management, and thus turn to rapidly mobilizing public and private means for survival. As the COVID-19 crisis continues, while specific policy agenda in rapid response may vary across jurisdictions and South Korea's model may not be easy to emulate, our analysis of South Korea's early response and results may provide insights for other countries (Lee, Heo, & Seo, 2020; Majeed, Seo, Heo, & Lee, 2020).

In April and May 2020, South Korea's governmental response to the COVID-19 pandemic was considered a general success by many international sources.^{2,3,4,5} While contact tracing received much of the policy attention, scholarly explanations on the underlying mechanisms of the South Korean model in fighting COVID-19 remained scarce, incomplete, and even misunderstood. The determinants of success were often explained through the lenses of bigger government and 'authoritarian residue',^{6,7} whereby South Korea was perceived to have citizens with relatively higher degrees of obedience who yield to government power due to the remnants of authoritarianism the country underwent in the 1970s and 1980s. The real reasons the system worked are quite different; moreover, checks and balances on the government by citizens were at the core of this success⁸ and the model relied heavily on voluntary participation by South Korean citizens.⁹ The interactions between public and government are evidenced by the institutions that have evolved at the demand of efficient governance and transparency, and the government has been compelled to respond to such requests in the form of policy implementation.^{10,11}

Observing the views from abroad, a clear-cut explanation of the inner workings of South Korean bureaucratic policymaking may be missing. Detailed country-specific expertise is required to effectively explain this model for future application by other countries. Contextually, such a research task would be difficult to undertake without looking into the formulation of the policy process with a

longer timeline of observation by comparing the current responses to COVID-19 with previous responses to precedence—that is, comparing the traumatic experience of the MERS in 2015 under an incompetent government with the present—and by a thorough examination of how the policy actually was activated and implemented. The MERS infection toll of 186 in South Korea was the highest of anywhere outside the Middle East, and resulted in 38 deaths.¹²

In an attempt to better explain the South Korean model of its responses to COVID-19, this article examines in depth the South Korean government's political motivations underlying one significant aspect, testing. The technology for RT-PCR test-kits to test MERS-CoV had already been developed by leapfroggers of the South Korean IVD industry, but they were not readily available at private medical facilities and were only utilized by the KCDC during the MERS outbreak in 2015, as EUA for enabling large-scale testing at private medical facilities did not exist then.¹³ After MERS, EUA was installed by the Ministry of Food and Drug Safety (MFDS) but lacked the large-scale testing component. Due to the unavailability of widespread testing sites during MERS, the long wait times of the test results from the KCDC, and the lack of information and transparency, impatient patients had gone to and from hospitals to be tested, causing cluster infections centered on hospitals.

RT-PCR test-kits for COVID-19 began to be developed by South Korean IVD firms right after the COVID-19 outbreak in China towards the end of 2019, and the leapfroggers were able to contribute with their technology because of soaring demand for tests nationwide at private medical facilities through the EUA process for large-scale testing. Testing has since been proven to be an essential process that enables tracking the virus and is the second component of the 3Ts (tracing, testing, treatment) in fighting COVID-19.¹⁴ South Korean health authorities learned from MERS that they must install an EUA process for RT-PCR test sites nationwide as the KCDC alone cannot handle all the tests in cases of cluster infections.

We conduct our analysis of government performance with thorough examinations on how the prerequisite environment of testing was created in a speedy manner in partnership with the private sector, by assessing and verifying quality reagents for testing at the early stage of COVID-19.¹⁵ To set the background of the rationale for large-scale testing, we focus on how the institutional and legal changes have come about post-MERS, as well as PPPs in the policy process and implementation at the time of COVID-19. We apply policy feedback theory, which highlights how precedence (Time 1) reshapes policy and politics, followed by a subsequent crisis (Time 2), and how the new political environment created as a result 'feeds' back into the creation of future policies (Mettler and SoRelle, 2014). We present our theoretical framework built on policy feedback theory and the grounds for PPPs, whereby many private actors are leapfrogging South Korean players in innovation.¹⁶

² Fisher, Max and Choe Sang-Hun. 'How South Korea Flattened the Curve,' The New York Times, Printed March 23, 2020 and updated April 10, 2020. <https://www.nytimes.com/2020/03/23/world/asia/coronavirus-south-korea-flatten-curve.html>.

³ Yoon, Dasl and Timothy W. Martin. 'How South Korea Put Into Place the World's Most Aggressive Coronavirus Test Program,' The Wall Street Journal, March 16, 2020. <https://www.wsj.com/articles/how-south-korea-put-into-place-the-worlds-most-aggressive-coronavirus-testing-11584377217>.

⁴ Brazinsky, Gregg A. 'South Korea is Winning the Fight Against COVID-19. The U.S. is Failing,' The Washington Post, April 10, 2020. <https://www.washingtonpost.com/look/2020/04/10/south-korea-is-winning-fight-against-covid-19-us-is-failing/>.

⁵ Ahn, Michael. 'How South Korea Flattened the Coronavirus Curve with Technology,' The Conversation, April 21, 2020. <https://theconversation.com/how-south-korea-flattened-the-coronavirus-curve-with-technology-136202>.

⁶ Kundnani, Hans. 'Coronavirus and the Future of Democracy in Europe,' Chatham House Expert Comment, March 31, 2020. <https://www.chathamhouse.org/expert-comment/coronavirus-and-future-democracy-europe>.

⁷ Brazinsky, Gregg A. *ibid*.

⁸ Kim, Tae-hoon. 'Why is South Korea beating coronavirus? Its citizens hold the state to account,' The Guardian, April 11, 2020. <https://www.theguardian.com/commentisfree/2020/apr/11/south-korea-beating-coronavirus-citizens-state-testing>.

⁹ Campbell, Charlie. 'South Korea's Health Minister on How His Country Is Beating Coronavirus Without a Lockdown,' Time, April 30, 2020. <https://time.com/5830594/south-korea-covid19-coronavirus/>.

¹⁰ Rogin, Josh. 'South Korea shows that democracies can succeed against the coronavirus,' The Washington Post, March 11, 2020. <https://www.washingtonpost.com/opinions/2020/03/11/south-korea-shows-that-democracies-can-succeed-against-coronavirus/>.

¹¹ Song, Ho-chang. 'How History Informed South Korea's Battle with COVID-19,' Asia Unbound, Council on Foreign Relations, April 23, 2020. <https://www.cfr.org/blog/how-history-informed-south-koreas-battle-covid-19>.

¹² Hwang Ji-hye and Hong Sung-jin, 'Alteration of Quarantine System since MERS outbreak in Korea,' Division of Quarantine Support, Center for Infectious Disease Control, Korea Centers for Diseases Control, August 11, 2016. https://www.cdc.go.kr/board/board.es?mid=a20602010000&bid=0034&list_no=70432&act=view.

¹³ Exclusive interview with Dr. Lee Hyuk-Min, Yonsei Severance Hospital and Korean Society for Laboratory Medicine, 'Private inspection, which was not possible during MERS, was different for Corona 19 (translated title),' Chungnyun-Euisa, February 29, 2020. <https://www.docdocdoc.co.kr/news/articleView.html?idxno=1077911>.

¹⁴ Power, John. 'South Korea's coronavirus response is the opposite of China and Italy - and it's working,' South China Morning Post, March 14, 2020. <https://www.scmp.com/week-asia/health-environment/article/3075164/south-koreas-coronavirus-response-opposite-china-and>.

¹⁵ Bicker, Laura. 'Coronavirus in South Korea: How 'trace, test and treat' may be saving lives,' BBC News, March 12, 2020. <https://www.bbc.com/news/world-asia-51836898>.

¹⁶ 'South Korea 2020,' Nature, May 27, 2020. <https://www.nature.com/collections/aeigdecjdj>.

We test our theoretical framework by content analysis (Hsieh & Shannon, 2005; Zaidman-Zait, 2014; Erlingsson & Brysiewicz, 2017)¹⁷ of the PPP on assessing RT-PCR (a molecular technology that detects and extracts the gene of Coronavirus, which is a single-stranded RNA from a patient sample, then uses a reverse transcriptase process to synthesize cDNA, or complementary DNA, which is amplified to check whether the patient has been infected by the Coronavirus (Gao, et al., 2020); (Lv et al., 2020)) test-kits from leapfrogging industry players (Fudenberg et al., 1983) in the IVD field (whereby a molecular technology that analyzes key DNA, RNA, or protein biomarkers [analytes] is used to identify a disease, determine its course, evaluate response to therapy, or predict individual predisposition to a disease) (Cheng, Kuan, & Chen, 2016; Debnath, GodavarthiPrasad, & Prakash, 2010) in South Korea. We concentrate on the South Korean health authorities' activation of EUA of the kits in a timely manner for an early response to COVID-19. We analyze data from "Our World in Data," an open-source that provides up-to-date figures on COVID-19 by country, to compare South Korea's early response in testing that helped contain the coronavirus in the country.

To closely examine how policy feedback theory works in our cases, we trail citizens' demand for government performance in pandemic governance using Gallup Korea opinion polls during Time 1 and Time 2. By observing former South Korean president Park Geun-hye's policies and public reaction to the MERS outbreak in 2015 and tracing the political stance of the current president, Moon Jae-in, in the months prior to COVID-19, we argue that the Moon Jae-in administration learned lessons from the past to thoroughly invest in fighting COVID-19 with a sense of urgency. Namely, the administration witnessed the negligence of the Park Geun-hye administration toward MERS and the political backlash in 2016 which contributed to impeachment in 2017.¹⁸ This lesson is evidenced by our analysis of Moon's official speeches, emphasizing MERS as a distinct past which South Korea has learned and evolved from.

At the onset of the COVID-19 crisis, pushed to the edge with mounting petitions to impeach Moon Jae-in for not blocking the borders to Chinese citizens¹⁹, the Moon administration was fully aware that its own performance results in pandemic governance would be critical to the general election on April 15, 2020. Moon's awareness is built on precedence: the vivid memories of failed measures to contain MERS by Park in 2015 and eventual impeachment of Park on other charges of corruption and inaction remained amongst the public. The Moon administration was indeed the byproduct of the impeachment, and thus chose to take early action to avoid what could have been the biggest jeopardy to the maintenance of power. We find in our analysis that, learning from the past and distancing itself from the damages of Park's sluggish policy reactions to MERS, the Moon administration bet entirely on fighting COVID-19 to win the general election on April 15, 2020, and the incumbent won by a landslide.

This article proceeds as follows. In the next section, we review the literature upon which our theoretical framework is built. We explain why combining policy feedback theory with elements of PPP provides a more accurate and explanatory framework for analyzing the South Korean case. The third section lays out the research design, where we explain our methodology in institu-

tional and content analyses and the data used. The fourth section contains a series of our findings from the analyses. The fifth section concludes with policy recommendations and future avenues for research.

2. Policy Feedback in Pandemic Governance: Leapfroggers in Public-Private Partnerships

2.1. Policy feedback theory

While political scientists, sociologists, and psychologists have researched a great deal about policies as results of political processes (Bobo et al., 1997; Carmines & Huckfeldt, 1996; Dennis, 1991; Verba, Schlozman, & Brady, 1995), far less has been said about the ways policies influence politics. Policy feedback theory highlights the dynamic and cyclical characteristics of policy and politics (Campbell, 2018). According to the theory, previous policies shape and reshape the political environment, which in turn contributes to future policymaking processes. In this manner, extant policies become inputs to the design and direction of new policies, having large and varied consequences for mass politics.

Much of extant scholarship in political behavior assumes a linear political process that runs from mass preferences and demands through elected intermediaries to policy outputs (see Milbrath & Goel, 1977; Verba & Nie, 1972; Yeric & Todd, 1996). These approaches treat citizens' individual decisions and actions as fundamental units of political input, and public policies as system outputs (Easton, 1953; Edelman, 1983). In this manner, politics came to be defined as "a sequence of reified processes that culminates in the authoritative allocation of values" (Easton, 1957). Mettler and Soss (Mettler & Soss, 2004) refer to these approaches as following a "standard framework" of social inquiry, where citizens become background actors in politics that exert indirect influence on public policy through elections (Pitkin, 1969; Pateman, 1970; Hardy-Fanta, 1993).

However, policies should not be understood as the ultimate product concluding a string of political events, disjointed from subsequent political procedures and new policies that follow. Once policies are enacted, they influence political thought and action among leaders and the public. In this way, public policy outcomes have important consequences for democratic citizenship. We identify the cases of pandemic governance across the Park and Moon governments as examples that show how public policy affects leaders' and citizens' goals, beliefs, and identities, opening or limiting possibilities for future political action (Mettler & Soss, 2004). In particular, both the broad policy environment at large as well specific public programs of pandemic governance (or the lack thereof) during Park's time became highlighted as critical weaknesses in governing competence and capacity, drawing citizens into active public life and leading to Moon's reorientation of governing priorities and identity as an effective administrator during COVID-19.

In an exemplary work incorporating policy feedback theory, Skocpol (1992) explains that policies created at Time 1 could reshape both state capacities and social groups and their political goals and capabilities, in turn affecting policies created at Time 2. Between Time 1 and Time 2, there are transformed state capacities, along with changes in social groups and their political goals and capabilities. In this article, the designation of timeframes Time 1 and Time 2 reflect Skocpol's explanation but take into consideration the timepoints of the outbreak and conclusion from both epidemiological and public policy perspectives. It is important to combine the two, as for Time 1, South Korean health authorities declared an end to MERS mainly from the public policy perspective and not the epidemiological perspective. Epidemiologically, there

¹⁷ 'Content Analysis,' Population Health Methods, Mailman School of Public Health, Columbia University. <https://www.publichealth.columbia.edu/research/population-health-methods/content-analysis>.

¹⁸ Choe, Sang-hun. 'South Korea Removes President Park Geun-hye,' The New York Times, March 9, 2017. <https://www.nytimes.com/2017/03/09/world/asia/park-geun-hye-impeached-south-korea.html>.

¹⁹ "Call for the impeachment of President Moon Jae-in" (translated), Blue House Petition February 4, 2020-March 5, 2020. <https://www1.president.go.kr/petitions/584936>.

was another MERS case on September 8, 2018, a 61-year-old male who had returned from Kuwait, but MERS did not spread overwhelmingly after his arrival in South Korea.

Here are the epidemiological/official announcements of outbreak and ending of MERS by the South Korean government for Time 1 and Time 2:

Time 1: Outbreak of MERS (Patient Zero on May 20, 2015 – epidemiological perspective) – Government Official Announcement on the end of MERS in South Korea (December 23, 2015 – public policy perspective). From the epidemiological perspective, strictly speaking, MERS continues, and the KCDC keeps a close watch. However, institutional changes from the public policy perspective for Time 1 are up until Time 2 begins, which is January 20, 2020.

Time 2: Outbreak of the COVID-19 (Patient Zero on January 20, 2020 – epidemiological and public policy perspectives) – present (ongoing, epidemiological and public policy perspectives)

In the South Korean case, institutional changes and legal amendments occurred right after the outbreak, both for MERS and COVID-19. The IDPCA was revised and updated multiple times to reflect immediate challenges. The revisions right after the MERS outbreak took place on July 6, 2015; December 2, 2016; March 27, 2018; and December 3, 2019. The revisions on these dates are the institutional changes that took place after MERS (Time 1). The revisions following the COVID-19 outbreak (Time 2) took place on March 4 and June 2, 2020, and subsequent revisions have occurred as COVID-19 unfolds (Lee, 2020). In other words, the institutional changes are continuous but can be divided into those after the MERS outbreak and those after the COVID-19 outbreak in South Korea.

Specifically, we suggest that former South Korean president Park Geun-hye's policy approach to MERS in 2015 (Time 1), which many consider a failure in capably containing the virus, not only shaped views about what constitutes effective policies in a pandemic situation but also brought about political turmoil that drastically rearranged the milieu of government (Lim & Sziarto, 2020). After the MERS virus rocked the country, South Korea set in stone a new form of social consensus via the IDPCA in 2016 that prioritizes public health safety to fight a pandemic.²⁰ The lessons learned from MERS (Lee and Ki, 2015) built legal precedence and formulated new institutional measures to avoid repetitive failures in the future.²¹ Eventually, when the COVID-19 pandemic broke out in 2020 (Time 2), the new political environment created as an aftermath of Park's governance enabled a completely different policy approach by the next president, Moon Jae-in (Oh et al., 2020; Ryan, 2020). The lessons learned from the past also raised the bar for Moon, with expectations of better performance than Park (Yi & Lee, 2020).

Policy feedback theorists argue that the design and implementation of policy feeds back into construction of the political system, as it affects the interests of various political actors including leaders—such as elected political elites, public officials, bureaucrats, and agencies—and the public. Leadership is developed and sustained through government policies, which critically influence political preferences and beliefs, how elites view themselves and others, and how they understand and act in the political system (Mettler & Soss, 2004). Among the citizenry, policy outcomes can influence public attitudes about the role of government, potentially enhancing or undermining political participation (Campbell, 2012). Policies and political behavior are thus socially constructed out-

comes that arise through the interaction of institutions, organizations, and actors (Stone, 2012).

The institutional changes on pandemic governance following MERS were not disassociated from the global discourse on disaster risk management. Just before the MERS outbreak in South Korea, a global agreement in utilizing PPP to manage disaster risks came about in the aftermath of the Fukushima Nuclear Plant Disaster in Japan in 2011. The agreement was signed by 187 states including South Korea²² at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, on March 18, 2015.²³ Thereafter, scholarship on disaster risks advocated for joint collaborative PPP in disaster risk management, with the development of management mechanisms along with clearly defined roles and responsibilities of actors involved and responsible business conduct (Eyerkauffer et al., 2016).

The impeachment of Park Geun-hye based on the charges of corruption and mismanagement of national disasters underlines her failures in many policy realms including MERS (Hahm and Heo, 2018). Thereafter, a political standard was set in South Korea by the public that does not allow political leaders to survive without demonstrating competency in crisis management. Park's negligence in acting swiftly and preemptively against MERS, among other incidents of perceived incompetence, formed views about what constitutes effective policies on both elite and public levels (Ku, Lee, & Woo, 2018). Frustration among the public regarding her performance in governance and inaction eventually led to a series of candlelight vigils and explosive demands for Park to step down from December 2016 until impeachment in March 2017, and the call for transparency and integrity institutions were made in this process (Shin & Moon, 2017; Turner, Kwon, & O'Donnell, 2018). Moon, from Park's opposing party, was then elected by popular support. Moon held contrasting political views to Park, but three years into office he began facing criticism for decaying South Korean democracy (Shin, 2020).

In early March 2020, as the virus spread quickly with a cluster infection in Daegu, citizens demanded that the pandemic governance be led by public health officials with expertise on the pandemic rather than by the president himself, indicating their memory of Park's policies on MERS. Compelled by the citizens and pressured by impeachment petitions, Moon's party pledged to elevate the KCDC from 'Center' to 'Agency' if elected. This became their main focus for the general election, and to demonstrate that they actually meant it, they immediately gave way to the KCDC to serve more independently as a control tower on behalf of the president.²⁴ The early response to the pandemic that had been absent in Time 1 under Park was activated in Time 2 under Moon by enabling large-scale testing via EUA by the KCDC in consultation with the MFDS to procure massive amounts of RT-PCR test-kits from South Korea's IVD industry through PPP (a mechanism that is explained in the following section). To ensure transparency that it lacked and had been criticized for in Time 1, the KCDC would hold daily briefings on COVID-19 followed by Q&A sessions from the press to be televised and streamed online through Facebook and YouTube in Time 2 to deliver correct and updated information and to prevent misinformation. This indicates that, congruent to policy feedback

²² Korea, Republic of: Sendai Framework data readiness review report, submitted by the Government of the Republic of Korea, 2017. PreventionWeb, UNDRR. <https://www.preventionweb.net/english/professional/policies/v.php?id=53155>.

²³ The Sendai Framework for Disaster Risk Reduction 2015–2030, United Nations Office for Disaster Risk Reduction, United Nations Headquarters New York, 2015. <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>.

²⁴ Chun, Sung-moo. 'Democratic Party "Promotes Disease Control Headquarters to 'Cheong (Agency)'"... 'If Moon commands, it will be the same as it is now' (translated), New Daily, March 1, 2020. <http://www.newdaily.co.kr/site/data/html/2020/03/01/2020030100050.html>.

²⁰ Infectious Disease Control and Prevention Act, Act No. 14286, December 2, 2016. Retrieved from Korea Law Translation Center on May 29, 2020. https://elaw.klri.re.kr/kor_service/lawView.do?hseq=40184&lang=ENG.

²¹ KSID White Paper on Chronicles of MERS, the Korea Society of Infectious Diseases, 2017. <http://www.ksid.or.kr/data/sub08.html>.

theory, the outcomes and legacies of Park's policies in Time 1 compelled new institutional actions under Moon in Time 2, and shifted budgets and resources to interest groups that support efficient pandemic-battling (Pierson, 1993).

In April 2020, shortly after many domestic and international sources agreed that Moon's government had successfully flattened the curve in South Korea, the country became the first to hold a nationwide election during the pandemic, at a time when other countries with upcoming elections announced postponements. The general election revealed a landslide victory for Moon's party, the Democratic Party of Korea, winning 163 seats along with a satellite party's 17 seats in the National Assembly (of which the number of total seats is 300), restructuring the political environment and granting Moon further political capital based on the highest public support rate to date during his term in office.²⁵ In this manner, consistent with the tenets of policy feedback theory, once policies were developed they affected crucial aspects of governance, reshaping politics, and earlier policies guided the prospect and probability of future policy creation (Béland, 2010).

In a nutshell, because South Korea had the opportunity to learn from the past and undergo institutional transformation from Time 1 to Time 2, it performed relatively efficiently compared to countries that lacked such a precedence. During the COVID-19 outbreak, many developed economies are experiencing Time 1, and policy feedback theory hints at the prospect that their governments might be expected to perform better at Time 2 if political feedback and policy learning occur from Time 1. In the case of South Korea, it just so happened that Time 1 arrived at an earlier point, and the government chose to learn from it. Even for the absolute monarchy of the Kingdom of Saudi Arabia, which was the epicenter of MERS, institutional changes occurred post-MERS affected its performance in pandemic governance during COVID-19 (Algaissi et al., 2020).

It is crucial to note that the main reason why policy feedback theory must be complemented with PPP and leapfrogging in order to best explicate the South Korean case is that policy feedback theory in and of itself does not guarantee improvement in policy or the yield of positive results from policy change. The institutional changes and the augmentation of transparency in policy delivery were the core elements of South Korea's early response to COVID-19, and incorporating these components require the deployment of PPP and leapfrogging to best explain how it was realized.

2.2. The grounds for Public-Private Partnership in pandemics

PPPs are long-term agreements between the government and a private partner whereby the private partner delivers and funds public services using a capital asset, sharing the associated risks.²⁶ In the international development literature, the necessity of PPPs in global health has frequently been subject to debate. The main criticisms range from the negative externalities of PPPs at the global level to the empowerment of private entities and economic interests centered in the Global North rather than the Global South (Buse and Harmer, 2004; Nishtar, 2004).

The main criticisms of PPPs had centered on the unequal distribution of power among the public, private entities, and global citizens, with the lion's share of interests yielded to the private sector. In the global health industrial domain, the criticisms of PPPs had a lot to do with the exercise of power by global pharmaceutical com-

panies known for their rent-seeking behavior through pharmaceutical patents, although they have yielded their interests in small part by efforts through compulsory licensing of patented medicines for manufacturing in developed economies (Sell, 2003). In the aftermath of the Global Financial Crisis in 2008, the reshaping of the private and public realm inherent to PPPs suggested a further deepening of the neoliberal management of individuals and populations, and allowed for private interest to become more embedded within the public sphere and to influence global and national health policymaking (Ruckert and Labonté, 2014).

Nonetheless, the positive effects of PPPs remained (Buse 2004), and in pushing the envelope further, different political strategies with regard to PPPs were emphasized for a reconfigured power dynamic between the relevant actors (Keane & Weerasinghe, 2008). In the case of global epidemics and pandemics, there is a compelling case for PPP, as governments may find it harder to deliver on their goals to protect public health without sufficient procurement of medical and pharmaceutical equipment from the private sector. This is becoming increasingly the case in a world in which the mutation of infectious viruses occurs at a rapid pace, without certainties on the delivery of a vaccine. For instance, in a rapidly unwinding pandemic situation such as COVID-19, in which expertise and knowledge are still being accumulated, government engagement with academic and private entities for the common goal of fighting infectious diseases—through funding for research and development, auditing, and assessing product quality assessment for immediate deployment—has become more or less inevitable (Steyer and Gilbert, 2013; Rao, 2013). The role of PPPs in strengthening health systems has now come into the limelight not only in the developed world ((Taylor and Christian, 2016); (Parker et al., December 2019)) but also in the developing world (Shrivastava et al., 2016).

The institutional changes that allowed for nationwide RT-PCR testing beyond the KCDC for testing in private medical facilities through the EUA under the IDPCA in tandem with augmented transparency in policy implementation was key to South Korea's early response to COVID-19. Policy feedback theory must be complemented with PPP and leapfrogging in order to best explain the South Korean early response in that a) policy feedback theory does not explicate the details of change nor guarantee success in Time 2, and b) PPP and leapfrogging fill in the detailed contents of pandemic governance – the forms of governance, in the context of policy feedback theory, through which the South Korean case can be fully explained.

In sum, reflecting upon the South Korean case requires a closer examination of how PPP was effectively utilized in Time 2 as a feedback to policy failure in Time 1. In South Korea, PPP in Time 2 effectively utilized upcoming and leapfrogging IVD companies, many of which were small and medium-sized enterprises (SMEs) in innovation (elaborated further in the following section). The pathways of PPP development and implementation are crucial in understanding the South Korean case of pandemic governance of COVID-19, in evidencing how it can actually work, while simultaneously catapulting pharmaceutical SMEs in IVD for their research caliber and global marketability of products in countries where applicable.

2.3. Leapfrogging in innovation by latecomers – South Korea

In the past decade, much of the research on latecomers in innovation have focused on China's innovation trajectories (Kennedy, 2018), with comparative assessments vis-a-vis other BRICS nations such as India (Kennedy, 2016). However, academic assessments on the case of South Korea on its post-2000 technological development by spearheading in innovation are relatively scarce, and to the best of our knowledge no attempt has been made to explain

²⁵ 'South Korea's governing party wins election by a landslide,' Al Jazeera, April 15, 2020. <https://www.aljazeera.com/news/2020/04/south-korea-ruling-party-wins-election-landslide-200416000355845.html>.

²⁶ OECD Principles for Public Governance of Public-Private Partnerships. <https://www.oecd.org/gov/budgeting/oecd-principles-for-public-governance-of-public-private-partnerships.htm>.

the rapid growth of the South Korean IVD industry in the time of COVID-19. The case is more meaningful given that the companies are SMEs, not South Korean chaebols or large conglomerates that have dominated the South Korean innovation scene in the past two decades.

While a plethora of research has been conducted on South Korea's rapid industrialization, coupled with democratization in the 1980s, the current trends of the nation's technological leadership cannot be explained solely based on pre-2000 literature on state-led growth, nor by earlier preliminary assessments on South Korea's rise in the semiconductor market in the 2000s and breakthrough in the 2010s, mainly spearheaded by Samsung and SK Hynix (Brown & Linden, 2009). The new trends in analyzing South Korea's post-development model are focused on the country's leapfrogging into the technological frontier post-Global Financial Crisis (Mahlich and Pascha, 2007), embodying key factors such as Internet-Communication Technology (ICT), automation, artificial intelligence, and the Fourth Industrial Revolution. Simply put, instead of being simply a 'fast follower', South Korea's proactive performance in these industries in recent years has much to do with the acceleration of technology and the industrial bind.²⁷ As life expectancy is extended, new trends of consumerism and elevated economic living standards encompassing expectations of better health conditions and medical technology have occurred in tandem with technological growth.²⁸ As we will discover in the findings section, South Korea's newly emerged pharmaceutical SMEs in the IVD industry were established post-Asian Financial Crisis (1997–8) in the early 2000s, as the South Korean economy was recovering from its economic rubble, indicating that they started from scratch.

The leapfrogging industries in South Korea's post-developmental state (Choung et al., February 2014) are different from previous state-supported entrepreneurship (Amsden, 1992; Evans, 1995; Wade, 2004). These industries promote an ecosystem that can support start-up companies that can grow and make business decisions independently from the government (Pacheco Pardo & Klingler-Vidra, 2019). In connecting leapfroggers to PPP, the fundamental rationale for collaboration by various entities derives from the stark realization that one actor is not enough to accomplish the technology required in the future due to the speed of development and competition. Furthermore, as the post-developmental state in South Korea evolves, there are new industries that the extant big players do not have a niche strategy for, and cooperation can be a better option than mere mergers and acquisitions in this regard. On January 27, 2020 – only one week after Patient Zero – the Infectious Diseases Analytics Center at KCDC, the Korean Society for Laboratory Medicine, and the leapfrogging RT-PCR test-kit producers of the IVD industry had a meeting. It was decided at the meeting that the leapfroggers were keen on an EUA for the RT-PCR test-kits for COVID-19. Chaebols were not at the meeting—not even Samsung Biologics, as RT-PCR test-kit production is not their forte. The leapfrogging SMEs in IVD had been working only on RT-PCR technology for the past two decades while Samsung had been churning out chips and cell-phones. Months later, Samsung became instrumental in constructing a smart factory system for RT-PCR test-kits by IVD leapfroggers Solgent, Kogenebiotech, and SD Biosensor, as well as masks for COVID-19—a system established with the initiative by the Ministry

of SMEs and Startups.²⁹ As such, Samsung Electronics contributed to expediting the production process for mass production for the leapfroggers but did not provide the main RT-PCR technology.

In the past decade, the alignment between government policy direction and industries became salient in South Korea, particularly in the energy sector (Park, 2013). New approaches aim to explain such post-developmental entrepreneurial trends (Moon, 2016; Cooke, 2017) and have paved the way for novel scholarship on South Korea's 'leapfrogging in innovation' (Lee, 2016, 2019; Lee & Malerba, 2017), in which South Korean SMEs play a significant part. Exemplary literature includes 'the Helix Model', which focuses on the linkages between industry, academia, and government in bilateral or trilateral research and development (R&D) partnerships for patent collaborations (Cho, 2014; Yoon, 2015; Sonn & Kang, 2016). Certain caveats of the current innovation trends have been raised, whereby government funding for business R&D is crucial (Kim & Lee, 2011) and university-industry collaboration fares the strongest trend (Yoon, 2015), indicating the tightness of cash in academia.

The gradual transition from the statist model to leapfrogging with the forge of trilateral partnerships among government, industry, and universities in South Korea indicates how the aforementioned PPPs can naturally come into the picture for public health crisis management. Such is evidenced by South Korea's policy process in Time 2 in granting leapfrogging players in the IVD market of EUA for the procurement and distribution of RT-PCR test-kits in a timely manner. The large-scale testing of COVID-19 in South Korea would not have been possible without the workflow of government, industry, and academia activating PPP to track down the virus.

3. Research Design

3.1. Theoretical Framework

Incorporating the theoretical framework of policy feedback theory and the conceptual framework for PPP in disaster management, we propose a new theoretical framework for governments facing pressures for better performance in pandemic governance. The framework is built with the aim to explain South Korea's policy response to COVID-19. While the conceptual framework by Auzzir, Haigh, and Amaratunga (2014) is centered mainly on the rationale and result of the PPP mechanism in disaster management, our framework upgrades and extends it by adding in an outer framework of the policy feedback mechanisms in Time 2, based on the lessons learned in Time 1 and the peculiar context of pandemic governance.

As Fig. 1 indicates, at the onset of the crisis as Patient Zero from China is discovered on January 20, 2020 in Incheon, South Korea (Kim et al., 2019), and as the virus spreads rapidly, the government is constantly in check by the citizens and is put under severe pressure for not closing the border. Public discontent is evidenced by poll ratings and official petitions for impeachment registered beginning early February.^{30,31,32} An existential crisis for the

²⁹ The augmented rate of productivity at the smart factory is largely owing to the adoption of barcodes, optimized logistics, domestic production of tubes for RT-PCR test-kits, and the automation of packaging and labeling. Press release, '73% increase in productivity due to the introduction of K-Diagnostic Kit (Solgent) and smart factory (translated),' Ministry of SMEs and Startups, June 10, 2020. <https://www.mss.go.kr/site/smba/ex/bbs/View.do?cbldx=86&bcldx=1019317&parentSeq=1019317>.

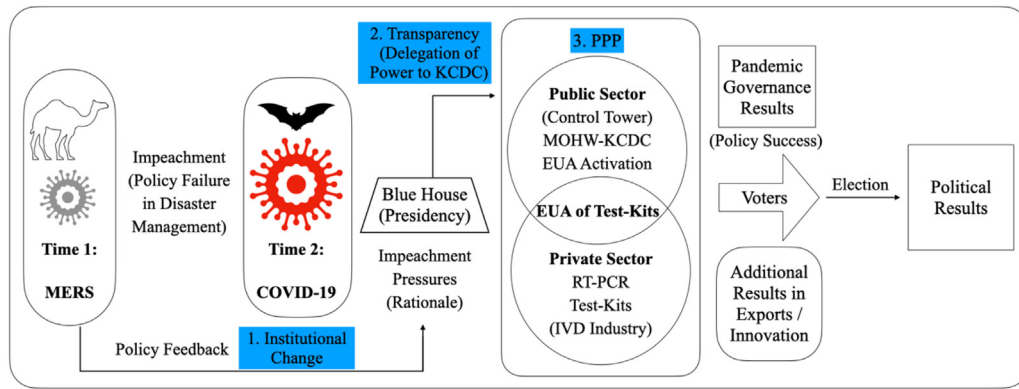
³⁰ The Blue House Citizens Petitions Board, 'Calling for Impeachment of President Moon Jae-in,' February 4, 2020 – March 5, 2020. <https://www1.president.go.kr/petitions/584936>.

³¹ Suzuki, Sotaro. "Hate China Virus" puts South Korea's Moon under pressure,' Nikkei Asian Review, February 10, 2020. <https://asia.nikkei.com/Spotlight/Coronavirus/Hate-China-virus-puts-South-Korea-s-Moon-under-pressure>.

³² Kim, Suki. 'How South Korea Lost Control of its Coronavirus Outbreak,' The New Yorker, March 4, 2020. <https://www.newyorker.com/news/news-desk/how-south-korea-lost-control-of-its-coronavirus-outbreak>.

²⁷ Dayton, Leigh. 'How South Korea made itself a global innovation leader: Systemic reform backed by strong investment has brought rapid and long-lasting results,' Nature, May 27, 2020. <https://www.nature.com/articles/d41586-020-01466-7>.

²⁸ Zastrow, Mark. 'Boosting South Korea's basic research: By redirecting funding to small teams, the country is betting on the creativity of its scientists,' Nature, May 27, 2020. <https://www.nature.com/articles/d41586-020-01464-9>.



Note: Developed based on Auzzir et al., 'Public-private partnerships (PPP) in disaster management in developing countries: a conceptual framework,' *Procedia Economics and Finance*, 18 (2014) 807-814. We combine this conceptual framework with the core elements of Mettler and SoRelle, 'Policy Feedback Theory,' in M. Weible, Christopher, and Paul A. Sabatier. eds.. *Theories of the Policy Process*. Westview Press, 2017.

Fig. 1. Conceptual Framework of PPPs for Pandemic Governance in a Policy Feedback Mechanism Note: Developed based on Auzzir et al., 'Public-private partnerships (PPP) in disaster management in developing countries: a conceptual framework,' *Procedia Economics and Finance*, 18 (2014) 807-814. We combine this conceptual framework with the core elements of Mettler and SoRelle, 'Policy Feedback Theory,' in M. Weible, Christopher, and Paul A. Sabatier. eds.. *Theories of the Policy Process*. Westview Press, 2017.

incumbents arises amid anti-Chinese sentiments, as the danger of potential policy failure looms. Only 10 days after discovery of Patient Zero from China, PPP mechanisms are introduced on January 30 to create the environment for large-scale testing.³³ Initial EUA is granted to Kogenebiotech on February 4 after evaluation screening, only two weeks into the first outbreak of COVID-19. KCDC effectively takes charge in containing the spread of the virus, as well as implementing specific policies such as extensive and large-scale testing practices and easy public access to testing facilities.³⁴ More independence is given to the KCDC under the Ministry of Health and Welfare (MOHW) to serve as the control tower, under the auspices of the Prime Minister's Office (and not the President's Office) compared to Time 1. One month into activation of the PPP and the EUA, South Korea succeeds in flattening the curve. Additionally, RT-PCR test-kit developers respond to subsequent KCDC calls for EUA. Those with EUA granted find themselves in excess supply after the curve has been flattened; together with those yet without EUAs that are granted approval for exports, they begin to export the RT-PCR test-kits abroad via Korean Air flights that transitioned suspended passenger airplanes due to COVID-19 into cargo planes, gaining global recognition.^{35,36} Positive responses on the test-kits from abroad gain international recognition for the South Korean IVD sector, with continuous requests for orders from some 101 countries, prompting the

government to set up a task-force solely for test-kits export.³⁷ Public opinion is swayed based on the performance in pandemic governance. Voters flock to the polls at Time 2 at a record-high voter turn-out rate of 66.2% to exercise their rights and to influence the direction of governance.^{38,39}

3.2. Methodology and data

We first conduct content analyses in institutional change by thorough observations of the South Korean case, focusing on the legal foundations that were altered between Time 1 and Time 2 for implementation. We then conduct content analysis of PPP implementation focusing on the EUA process for RT-PCR test-kits, from decision to call for application, vetting and evaluation, and adoption for testing. On the documentation of South Korea's responses to MERS, we relied on past government documents of the Special Committee Activity Report on Responses to MERS (2015) and the verbatim record from their meetings, as well as documentation from the South Korean epidemiological experts on MERS (i.e., White Paper on MERS) and provincial government records. We also relied on previous South Korean media reports of the Park administration on MERS. We depended largely on South Korean government sources on the EUA process through press releases by the KCDC and the MFDS. We closely monitored the briefings of the KCDC on COVID-19 beginning January 28, 2020, which air every weekday at 2:10PM supplemented by Sunday briefings by the MOHW at 5:00PM Korea Standard Time based on the daily briefing documents issued, via the KTV YouTube channel (<https://www.youtube.com/user/chKTV520>) and KTV Facebook Live, as well as the intermittent briefings by the MFDS on masks

³³ Press Release, 'Public-Private Partnership accelerates Coronavirus Diagnosis (translated),' Ministry of Health and Welfare, January 30, 2020. http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&CONT_SEQ=352571.

³⁴ Press Release, 'Emergency Use Authorization for Test-kits of the Novel Coronavirus, testing availability extended to hospitals (translated),' Ministry of Health and Welfare, February 4, 2020. http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1&CONT_SEQ=352683.

³⁵ Korean Air Newsroom, 'The Republic of Korea produces, and Korean Air delivers' (translated), April 28, 2020. <https://news.koreanair.com/%EC%98%81%EC%83%81-%EB%8C%80%ED%95%9C%EB%AF%BC%EA%B5%AD%EC%9D%B4-%EB%A7%8C%EB%93%A4%EA%B3%A0-%EB%8C%80%ED%95%9C%ED%95%AD%EA%B3%B5%EC%9D%B4-%EC%88%98%EC%86%A1%ED%95%A9%EB%8B%88%EB%8B%A4/>.

³⁶ Korean Air Newsroom, 'Korean Air ranks No. 1 in Air Cargo Excellence Award (translated),' April 22, 2020. <https://news.koreanair.com/%EB%8C%80%ED%95%9C%ED%95%AD%EA%B3%B5%EC%9D%B4-%EB%A7%8C%EB%93%A4%EA%B3%A0-%EB%8C%80%ED%95%9C%ED%95%AD%EA%B3%B5%EC%9D%B4-%EC%88%98%EC%83%81-diamond-%ec%88%98%ec%83%81/>.

³⁷ Ministry of Foreign Affairs, 'The First Meeting of the Inter Ministerial Task Force on COVID-19 Related Quarantine Equipment Export Abroad (translated),' March 26, 2020. http://www.mofa.go.kr/www/brd/m_4080/view.do?seq=370104&srchFr=&srchTo=&srchWord=&srchTp=&multi_itm_seq=0&itm_seq_1=0&itm_seq_2=0&company_cd=&company_nm=.

³⁸ '(5th LD) Tentative voter turnout at 28-year high of 66.2 pct despite coronavirus,' Yonhap News Agency, April 15, 2020. <https://en.yna.co.kr/view/AEN20200415000855325>.

³⁹ Kuhn, Anthony, 'In South Korea, Success Fighting the Virus Brings Success at the Ballot Box,' NPR, April 16, 2020. <https://www.npr.org/2020/04/16/835710358/in-south-korea-success-fighting-the-virus-brings-success-at-the-ballot-box>.

provision via the same channel. We also relied in part on the press releases of the Special Committee on the Responses to COVID-19 established in February 2020.

The basic tenets of policy feedback theory highlight how both the public and leaders can learn from the political effects of past policies to design new ones. For the EUA on South Korean test-kits from the U.S. for nationwide use, we depended on the EUA process and data from the USFDA, the test-kits supply data from MOHW, and export data from South Korean Customs and the Ministry of Finance and Economy. We utilize "Our World in Data" of the Global Change Data Lab for figures on daily testing per population in South Korea. We add assessments of policy based on political performance after pandemic governance in Time 1 and Time 2, based on poll ratings from Gallup Korea. Weekly public opinion polls that assess the South Korean public's evaluations of the president's governance as either positive or negative, as well as the respondents' reasons for such evaluations, were analyzed from just before the outbreak of pandemics and throughout their duration. These span both former South Korean President Park Geun-hye's support rates during the time MERS hit South Korea in 2015, as well as current President Moon Jae-in's policies to battle COVID-19 in 2020. We also provide a policy assessment of political performance in Time 1 and Time 2. Data visualization of the change in public support shows that, congruent with the tenets of policy feedback theory, the political consequences of policy feedback (as either success or failure) reshaped the ensuing political environment. While the public's disappointment in Park's failing to contain MERS was a contributing factor to Park's impeachment and removal from power, the public's perception of the effectiveness of Moon's COVID-19 policies impacted the success of Moon's political party in the general elections that followed on April 15, 2020.

Finally, for further evidence that Park's failure to efficiently contain MERS in South Korea was a contributing factor to impeachment, and that Moon did indeed face the political consequences of Park's (mis)management of MERS in dealing with COVID-19, we analyze primary sources on the South Korean Constitutional Court's decision for impeachment and Moon's official speeches, respectively. Moon's speeches range from the first outbreak of COVID-19 on January 30 to May 8, 2020, which is the most recent date the government released Moon's speeches in full.

4. Findings

4.1. Institutional changes post-MERS (Time 1) and new responses in COVID-19 (Time 2)

Significant institutional changes have been made since the time of MERS and during the time of COVID-19. Most importantly, extant legal foundations of the IDPCA were amended. Revisions of the IDPCA⁴⁰ were made in 2015, and additional amendments were made in 2020 for more effective and stronger quarantine.^{41,42} The legal changes paved the way to allow conditional use of personal data to activate the Smart Management System developed by the Ministry of Land, Infrastructure and Transport (MOLIT).⁴³ More

importantly, what enabled an early response and the creation of a nationwide large-scale testing environment was the amendment of the enforcement decree of the IDPCA, passed via a fast-track process in the National Assembly on February 26 coming into effect beginning March 3, 2020. The amendment of the IDPCA allowed for large-scale RT-PCR testing free of charge to all South Korean citizens nationwide under Article 6. The KCDC and the MFDS were swift in activating the EUA system to vet for high-quality RT-PCR test-kits from the pharmaceutical sector, and as we will see in the following section, most of them were up-and-coming, small-scale innovators that had R&D support from both public and private sectors. In addition, with the delegation of power to govern the pandemic to the MOHW, the KCDC placed under the MOHW acted as the apparent and authoritative main headquarters and control tower for COVID-19, avoiding confusion in guidance delivery to the public. Such efforts were compounded by the election campaign agenda to elevate KCDC status from 'Center' to 'Agency', while the president took a step back and left the crucial specific matters related to pandemic governance to the specialists KCDC authorities. The institutional memory is crucial to governing pandemics.^{44,45} The key factors to take into consideration in terms of institutional change are laid out in Table 1.

4.2. PPP on RT-PCR Test-kits for implementation during COVID-19 (Time 2)

This section lays out the details of PPP on RT-PCR Test-kits from the onset of the COVID-19 outbreak in South Korea. Specifically, it draws on a) how the South Korean public health system actually functioned to create a large-scale testing environment nationwide by collaborating with the private sector, and b) how leapfrogging SMEs became the main providers of RT-PCR test-kits in South Korea through the EUA under the Medical Devices Act (as amended in 2019).⁴⁶

1) PPP in the EUA Process for the IVD Industry in South Korea during COVID-19

Prior to COVID-19, South Korea utilized the Pancoronavirus RT-PCR testing method (Vijgen et al., 2008) to detect coronaviruses during MERS in 2015. The Pancoronavirus testing method was cumbersome and would take at least 24 hours and up to 2 days until final confirmation, as the process entailed the initial selection of all coronaviruses for human infection (HCoV 229E, HCoV NL63, HCoV OC43, HCoV HKU1, SARS-CoV, MERS-CoV) and detection of the novel coronavirus (SARS-CoV-2) through the process of contrasting.⁴⁷ In the interest of time, the KCDC announced that it would depart from the Pancoronavirus testing method. The new RT-PCR testing method would cut down the testing time to only 6 hours, which would entail a) extracting the sample from the patient through the nasal area using cotton swabs, b) selecting RNAs from the sample in a negative pressur-

⁴⁴ Pardo, Ramon Pacheco et al., 'Preventing the Next Pandemic: Lessons from East Asia,' Kings College London, May 2020. <https://www.kcl.ac.uk/eis/assets/kdefre-searchreport2020-a4-proof2-singlepage.pdf>.

⁴⁵ Pardo, Ramon Pacheco and Jeong-ho Lee, 'South Korea's COVID-19 Success: The Role of Advance Preparations,' KF-VUB Korea Chair Policy Brief, May 29, 2020. https://www.korea-chair.eu/wp-content/uploads/2020/05/KFVUB_Policy-Brief-2020-07.pdf.

⁴⁶ Terhune, Chad, Dan Levine, Hyunjoon Jin, Jane Lanhee Lee. 'Special Report: How Korea trounced U.S. in race to test people for coronavirus,' Reuters, March 19, 2020. <https://www.reuters.com/article/us-health-coronavirus-testing-specialrep/special-report-how-korea-trounced-u-s-in-race-to-test-people-for-coronavirus-idUSKBN2153BW>.

⁴⁷ Press Release, 'Approved for emergency use of new coronavirus diagnostic reagents, expanded testing to medical institutions: testing available at private medical institutions from February 7th (translated), Ministry of Health and Welfare, February 4, 2020. 'http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1&CONT_SEQ=352683.

⁴⁰ Infectious Disease Control and Prevention Act (IDPCA), Act No. 14286, December 2, 2016. https://elaw.klri.re.kr/kor_service/lawView.do?lang=ENG&hseq=40184.

⁴¹ Lee, Gyooho, Legislative and Administrative Responses to COVID-19 Virus in the Republic of Korea (April 28, 2020). Available at SSRN: <https://ssrn.com/abstract=3587595> or <https://doi.org/10.2139/ssrn.3587595>.

⁴² Kim, Brian. 'Lessons for America: How South Korean Authorities Used Law to Fight the Coronavirus,' Lawfare, March 16, 2020. <https://www.lawfareblog.com/lessons-america-how-south-korean-authorities-used-law-fight-coronavirus>.

⁴³ COVID-19 Smart Management System (Korea), Smart City Korea, Ministry of Land, Infrastructure and Transport, Republic of Korea. <https://smartcity.go.kr/en/2020/04/13/covid-19-smart-management-systemkorea/>.

Table 1
Institutional Changes of South Korean Pandemic Governance in Time 1 and Time 2.

Components of Policy Response	MERS (Time 1)	COVID-19 (Time 2)
1. Legislative Effort on Enforcement	Revision of the existing Infectious Diseases Prevention and Control Act (IDPCA in 2015) occurred post-MERS: - Article 76–2(1): Equips the Minister of Health and Welfare extensive legal authority to collect private data without warrant from confirmed and potential patients; expressly mandates that private telecommunications companies and the National Police Agency share such data with health authorities at their request. - Article 76–2(2): Enables the health minister and the KCDC head to require “medical institutions, pharmacies, corporations, organizations, and individuals” to provide “information concerning patients... and persons feared to be infected.” - Article 6 and 34–2: Invokes the public’s right to know and requires the Minister of Health and Welfare to “promptly disclose information” regarding the spread of virus to the public. - Article 47(1): Empowers authorities to shut down any location “deemed contaminated”. Revision of the enforcement decree of the existing Medical Devices Act (MDA) of 2018 (in effect since January 23, 2019) - Article 46(2): Allows for medical equipment producers without manufacturing licenses to produce, or importers without licenses of to import - Article 13(2): Empowers the MFDS to allow for testing of infectious diseases under the IDPCA based on Article 46(2)	Promulgation of the enforcement decree of the IDPCA was passed by the National Assembly on February 26, 2020. ¹ Amendment on March 3, 2020: - Article 6: Stipulates that all citizens have a “right to receive the diagnosis and medical treatment of any infectious disease” and the “State and local governments shall bear expenses incurred within.” - Enforces a punitive measure for breaking self-quarantine at up to 1,000,000 South Korean won or 1 year in prison. ² - Grants officials the legal authority to make “necessary means to make masks available to children and the elderly in a public health crisis involving any respiratory virus.” - Articles 50–56: Mandates “disinfection duty” for the government.
2. Early Response by Authorities	Patient Zero detected on May 18, but testing given May 19 and confirmed later (May 20, 2015).	Patient Zero (January 20, 2020) from Wuhan, China, detected at Incheon International Airport and immediately hospitalized in a designated isolation hospital via PCR testing (Kim et al. 2020).
3. Clear Presence of Control Tower	Unclear, with several overlapping public entities with varied channels in place: Acting Prime Minister; Ministry of Public Safety and Security; Ministry of Health and Welfare	Clear and present. Ministry of Health and Welfare (under which KCDC is placed)
4. Empowering KCDC as Independent Control Power	Bipartisan bills raised by politicians (Chung Choun-sook, Democratic Party of Korea; Park In-sook, then Liberal Party of Korea) in June and July 2017, failed.	Elevation of KCDC becomes election campaign slogan for incumbent party toward election. Post-election, bipartisan effort for elevation of KCDC in the 21st National Assembly based on the 2017 bill drafts. KCDC is elevated to KDCA on September 20.
5. Emergency Use Authorization (EUA) for RT-PCR Test-kits	Installed by MFDS in June 2016, as a result of MERS, activated a month after Patient Zero, and ended on August 4, 2017. ³ Large-scale testing mechanism absent.	Activated for establishing a nationwide large-scale testing mechanism in consortium by MFDS and KCDC, only one week after Patient Zero. 64 producers that are leapfrogging innovators in the South Korean IVD industry respond to the call for EUA as a PPP process between January 28 and February 28 ⁴ , of which four producers were granted EUA, making available approximately 520,000 tests as of March 9.
6. Transparency	KCDC strategy focuses mainly on blockade of single hospital unit but fails, causing widespread intra- and inter-hospital infections by patients seeking treatment from hospital to hospital. Due to hospitals’ seeking confidentiality to protect their brand names, transparency is lost in the process. A resolution that calls for a) the investigation by the South Korean Board of Audit and Inspection into responses to MERS and b) the improvement of infectious diseases management mechanism is passed by the National Assembly. ⁵	Much of the misinformation that proliferated at the beginning of the outbreak is clarified through briefings when public health authorities start to hold live briefings on January 28, 2020, streamed live online through Facebook and YouTube through the KTV channel. The briefings by health authorities update the current status of COVID-19 and are coupled with Q&A sessions for the press attending online and offline from Seoul, Sejong, and Osong cities, as government facilities are spread out across them. The main briefing is held by the KCDC, led by Jung Eun-kyung ⁶ and Kwon Joon-wook; and its superior authority, MOHW, with minister Park Neung-hoo and Kim Gang-lip. The MFDS also delivers briefings on the situation of mask provision, coupled with Ministry of Interior and Safety briefs on central disaster safety measures developments.

Source: Compiled from Ministry of Health and Welfare press releases and relevant news reports. Details on policy responses on MERS compiled from the Report of the Response to MERS Special Commission (Translated), a 500-page report published by the Health and Welfare Committee of the National Assembly of the Republic of Korea in July 2015 (<https://health.na.go.kr:444/health/reference/reference04.do?mode=view&articleNo=529863>), and Verbatim Record of Response to MERS Special Commission Meetings (Translated), a verbatim record of the MERS Special Committee Meeting on July 28, 2015 retrieved from the National Assembly Library of Korea. Relevant legal provisions from the Korea Legislation Research Institute and the Korea Law Translation Center (KLT) for English versions of the South Korean legal text.

¹ Enforcement Decree of the Infectious Disease Control and Prevention Act, Presidential Decree No. 29180, September 18, 2020 and amended March 3, 2020. https://elaw.klri.re.kr/kor_service/lawView.do?hseq=49724&lang=ENG.

² ‘Flattening the Curve on COVID-19: How Korea responded to a pandemic using ICT,’ Office of the Spokesperson, Ministry of Justice, the Republic of Korea. April 16, 2020. http://www.moj.go.kr/moj_eng/1765/subview.do?jsessionid=qKkGETvTipwQ8657rm5DDv8Ux6wsrNCCghIW1rM9.wizard-7-q6rcs?enc=Zm5jdDF8QEB8JTJ-GYmJzJTJGbw9qX2VuZyUyRjUxJTJGNTlyODlyJTJGYXJ0Y2xWaWV3LmRvJTNG&fbclid=IwAR3oNo4QD3hzLdLd59r29_vHrmbt7CO1kRLFd1PKRqlcDD6owQnqPCh00.

³ Press Release, ‘Conclusion of the EUA for MERS Zica Virus Test Reagents... Continued Testing Available at Private Medical Institutions Using Authorized Products (Translated),’ Ministry of Health and Welfare, August 4, 2017. http://www.mohw.go.kr/front_new/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=1&CONT_SEQ=340898.

⁴ Press Release, ‘64 Applications for EUA of COVID-19 Diagnostic Kits (Translated),’ Medical Equipment Policy Bureau, Ministry of Health and Welfare, March 10, 2020. https://www.mfds.go.kr/brd/m_99/view.do?seq=44010&srchFr=&srchTo=&srchWord=&srchTp=&itm_seq_1=0&itm_seq_2=0&multi_itm_seq=0&company_cd=&company_nm=&page=1.

⁵ Press Release, ‘Resolutions requesting for audit by the Board of Audit and Inspection and the reform of infectious diseases management system and the conclusion of the Response to MERS Special Commission activities of the National Assembly (Translated),’ the National Assembly of Korea, July 28, 2015. https://www.assembly.go.kr/assm/notification/news/news02/bodo/bodoView.do?bbs_id=ANCPUBINFO_04&bbs_num=39807&no=1665&CateGbn=4&GbnTitle=

⁶ Walker, Sam. ‘Thank God for Calm, Competent Deputies,’ The Wall Street Journal, April 4, 2020. <https://www.wsj.com/articles/in-the-coronavirus-crisis-deputies-are-the-leaders-we-turn-to-11585972802>.

ized room setting to prevent infection, and c) synthesizing complementary DNA (cDNA) using reverse transcriptase on the RNA and amplifying the cDNA, which is then verified in a real-time graphic imagery by time.⁴⁸ There are other methods based on antibody testing (serological testing), but antibody tests have been under criticism for not ensuring complete accuracy.^{49, 50} In South Korea, only RT-PCR testing was used to detect COVID-19, as the KCDC prioritized ensuring accuracy of the test results. Kwon Jun-wook of the KCDC provided a firm case for adopting RT-PCR testing to ensure accuracy in the Q&A sessions of the press briefings on March 15⁵¹ and again on May 30⁵² that given the questions remaining on accuracy of antibody tests, KCDC is not considering antibody tests for EUA. Um Joong-shik of the Korean Society for Healthcare-associated Infection Control and Prevention has also been quoted as saying that the U.S. and Europe can no longer provide a standard for South Korea – and that thus far no country other than South Korea has been able to conduct 25,000 RT-PCR tests per day, ensuring the capacity of such testing in South Korea. He also voiced concerns about adopting antibody tests which would bring about immeasurable confusion in the current system of COVID-19 diagnosis and treatment.⁵³

Based on Article 42(2) and enforcement decree 13(2) of the Medical Devices Act amended in 2019 (as mentioned in Table 1), South Korean public health authorities moved quickly to call for applications for EUA in RT-PCR test-kits on January 28.⁵⁴ The first call would entail a vetting and evaluation process of the kits for one month until February 28, during which qualifying kits would be granted EUA in the order of application. As early as January 30, the KCDC (inclusive of the National Incheon Airport Quarantine) as well as 18 other public health institutions nationwide announced extended testing service to private hospitals throughout the country on February 7.⁵⁵ On February 5, the KCDC announced its success in isolating the novel Coronavirus from an infected patient (Park et al., 2020), under the name BetaCoV/Korea/KCDC03/2020, declaring the information of the genome would be listed under the GISAID of the World Health Organization for R&D to assist in vaccine development by researchers of South Korea and around the world.⁵⁶

The KCDC vetting process of RT-PCR test-kits would then proceed in cooperation with the MFDS, whereby the MFDS upon the

KCDC's request would review the documents and conduct an assessment in consortium with the KCDC and experts from the Korean Society for Laboratory Medicine. The test-kit products that pass the vetting process would be authorized by the MFDS for EUA upon the KCDC's request, upon which the manufacturers could make sales independently to public and private hospitals and treatment centers where large-scale testing is being conducted nationwide (Fig. 2). As of May 29, 2020, there are seven South Korean RT-PCR test-kit manufacturers that have passed the KCDC-MFDS vetting process (Table 2). The procurement through PPP enabled the preparation of approximately 500,000 tests in South Korea, where on average two tests are conducted per individual, enabling testing of 250,000 cases per week. The vetting process for EUA is ongoing for other manufacturers with export licenses down the application list (see Figs. 3 and 4).

As seen in Table 2, with the exception of BioSewoom, six out of seven "leapfrogger" companies that were issued EUAs as of May 29, 2020, were established from the year 2000 and onwards, which means that they are relatively young companies with strong research caliber, considering the growth period involving extensive R&D in the pharmaceutical industry including IVD. They are leapfroggers also in the sense that they are SMEs, as only Seegene and Biocore are sizeable companies listed on the Korea Exchange (KRX), with SolGent on course to be listed in 2021, whereby being listed for trading shares on the KOSDAQ market requires company capital of 30 billion South Korean won.⁵⁷ The PPP process provided them with the opportunity to showcase their quality and prospects in the biopharmaceutical sector. Among them, six out of the seven companies have been issued EUA by the United States by the USFDA as of July 31, 2020, through a vetting process that South Korean manufacturers of test-kits had also applied for in the U.S. in tandem with the domestic process by the KCDC and MFDS (Table 3).

2) Excess Supply Exports of RT-PCR Test-kits after Flattening the Curve

RT-PCR test-kit companies that are still awaiting EUA results from the KCDC and the MFDS that are authorized for sale abroad by the South Korean authorities have been showcasing their products abroad to COVID-19 affected countries, not only to the U.S. but also globally, through another platform of PPP prepared by the Ministry of Trade, Industry and Economy and the Korea International Trade Association.⁵⁸ Such PPP efforts in exports of the test-kits were made possible in large part owing to production capacity by the manufacturers and the early response with large-scale testing which flattened the curve, allowing for excess supply to be sold abroad, effectively gaining international recognition for such companies. With soaring demands for South Korean RT-PCR test-kits from abroad, in order to facilitate the ordering process by foreign buyers, the MOHW compiled a list of manufacturers authorized for exports with details of products and links to respective company websites for contact. The list has been uploaded on the Korea Health Industry Development Institute website.⁵⁹ Noting the time sensitivity of the

⁴⁸ Jawerth, Nicole. 'How is the COVID-19 Virus Detected using Real Time RT-PCR?', International Atomic Energy Agency, March 27, 2020. <https://www.iaea.org/news-center/news/how-is-the-covid-19-virus-detected-using-real-time-rt-pcr>.

⁴⁹ Ulrich, Angela et al. 'COVID-19: The CIDRAP Viewpoint: Part 3, Smart Testing for COVID Virus and Antibodies,' Center for Infectious Disease Research and Policy, University of Minnesota. May 20, 2020. <https://www.cidrap.umn.edu/sites/default/files/public/downloads/cidrap-covid19-viewpoint-part3.pdf?fbclid=IwAR3bzm-cz9P8s755X5c4W-ROBpmbz3dpMFXzt55H0sMt1tgi-48zVqxjZJAg>.

⁵⁰ Fox, Maggie. 'Coronavirus testing is 'a mess' in the US, report says,' CNN Health, May 21, 2020. <https://edition.cnn.com/2020/05/20/health/testing-coronavirus-cidrap-report/index.html?fbclid=IwAR3LLRagKLvO4XQBvYhNwT2PMVDIjdcklUa3m8-Hrl8TclMdyMk-UMJET4>.

⁵¹ [Breaking News] Government "Convinced of the accuracy of domestic diagnostic kits... USFDA remarks are presumed (translated)", Hankook Ilbo, March 15, 2020. <https://www.hankookilbo.com/News/Read/202003151424095013>.

⁵² KCDC "Introduction of autoantibody testing in Korea is yet to be decided (translated)," Medical Observer, May 30, 2020. <http://www.monews.co.kr/news/articleView.html?idxno=211074>.

⁵³ 'Controversy over the use of antibody diagnostic kits' (translated), Medical Times, March 23, 2020. <https://www.medicaltimes.com/Users/News/NewsView.html?ID=1132705>.

⁵⁴ Press Release, '[Infectious Disease Diagnosis Management Division] Announcement of Application and Evaluation for Approval of New Coronavirus Gene Test Reagent Emergency Use,' Korea Centers for Disease Control, January 28, 2020. https://www.cdc.go.kr/board/board.es?mid=a2050500000&bid=0017&act=view&list_no=365883&tag=&nPage=1.

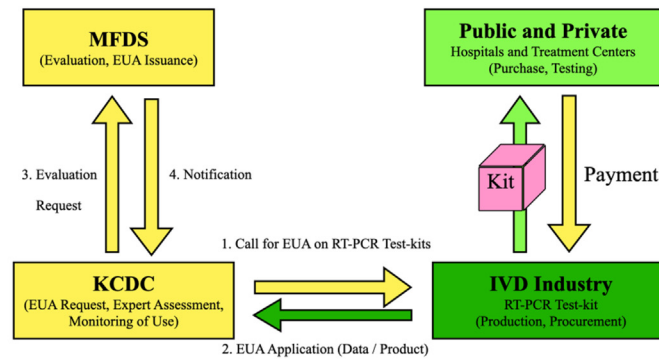
⁵⁵ Press Release, 'Private-public cooperation will speed up the diagnosis of novel coronavirus,' (translated), Korea Centers for Disease Control, January 30, 2020. https://www.cdc.go.kr/board/board.es?mid=a20501000000&bid=0015&act=view&list_no=365897.

⁵⁶ Press Release, 'KCDC succeeds in separating novel coronavirus, publicizes genetic information,' Korea Centers for Disease Control, February 5, 2020. <https://www.cdc.go.kr/board/board.es?mid=a20501000000&bid=0015>.

⁵⁷ Requirements for Listing on the KOSDAQ market, '[Partly amended on April 29, 2020, Regulation No. 1815 <Enforcement Date: May 8, 2020>,' KRX Legal Service. <http://law.krx.co.kr/las/TopFrame.jsp>.

⁵⁸ Press Release, 'Public-private joint venture opened a road for exports: Korea International Trade Association -Ministry of Trade, Industry and Energy transport 34 tons of emergency air cargo to China and Indonesia using idle airliners,' (translated), Korea International Trade Association, April 29, 2020. <https://www.kita.net/asocGuidance/nesDta/nesDtaDetail.do?pageIndex=1&sNo=9144>.

⁵⁹ 'List of COVID-19 IN Vitro Diagnostics Device,' Ministry of Health and Welfare, April 1, 2020. <https://www.khidi.or.kr/board/view?pageNum=1&rowCnt=20&no1=9999999997&linkId=48825484&refMenuId=MENU01499&menuId=MENU01498&maxIndex=00488257649998&minIndex=00488175749998&schType=0&schText=&schStartDate=&schEndDate=&boardStyle=&categoryId=&continent=&country=>



Source: Developed and updated based on Press Release, ‘[보도참고] 코로나19 진단시약 긴급사용승인 64건 신
청: 42개 업체에서 64건 신청, 19건 검토완료 (4건승인), 45건 검토 중,’ Ministry of Food and Drug Safety
(MFDS), March 10, 2020. https://www.mfds.go.kr/brd/m_99/view.do?seq=44010&srchFr=&srchTo=&srchWord=&srchTp=&itm_seq_1=0&itm_seq_2=0&multi_itm_seq=0&company_cd=&company_nm=&page=1

Fig. 2. PPP Implementation 1 in Early Response to COVID-19: EUA Process by KCDC and MFDS. Source: Developed and updated based on Press Release, ‘64 Applications for EUA of COVID-19 Diagnostic Test-kits from 42 entities, of which 19 were reviewed, 4 authorized for EUA, 45 under review (Translated),’ Ministry of Food and Drug Safety (MFDS), March 10, 2020. https://www.mfds.go.kr/brd/m_99/view.do?seq=44010&srchFr=&srchTo=&srchWord=&srchTp=&itm_seq_1=0&itm_seq_2=0&multi_itm_seq=0&company_cd=&company_nm=&page=1.

Table 2
South Korean Producers of RT-PCR Test-Kits issued EUA by KCDC and MFDS (As of May 29, 2020).

Company/[KRX No.]	Established Year	KRX Listed Date	Date of EUA by KCDC	Product Name	Technology/Target Genes (RNA)	EUA Issued by USFDA
Kogenebiotech Co. Ltd.	2000	NA	02/04/2020	PowerChek™ 2019-nCoV RTPCR Kit	Molecular (PCR)/RdRp, E	Yes
Seegene, Inc. [A096530]	2000	09/10/2010	02/12/2020	Allplex™ 2019-nCoV Assay	Molecular (PCR)/RdRp, E, N	Yes
SolGent Co., Ltd.	2000	Expected in 2021	02/27/2020	DiaPlexQ™ Novel Coronavirus (2019-nCoV) Detection Kit	Molecular (PCR)/ORF1a, N	Yes
SD Biosensor, Inc.	2010	NA	02/27/2020	Standard™ M nCoV Real-Time Detection Kit	Molecular (PCR)/RdRp, E	Yes
BioSewoom	1997	NA	03/13/2020	Real-Q 2019-nCoV Detection Kit	Molecular (PCR)/RdRp, E	Yes
Biocore [A216400]	2001	06/29/2015	05/11/2020	BioCore 2019-nCoV Real Time PCR Kit	Molecular (PCR)/RdRp, N	Yes
WELLS BIO (Parent: ACCESSBIO [A950130])	2013	NA	05/29/2020	careGENE™ N-CoV RT-PCR kit	Molecular (PCR)/RdRp, E	NA

Source: Compiled from various sources. Company history data based on respective company official websites and Korea Exchange (KRX) if a company is listed for trading on KRX. EUA information from KCDC based on the following three updates: on April 4, 2020 (http://www.cdc.go.kr/board.es?mid=a20504000000&bid=0014&act=view&list_no=366585), on May 11, 2020 (http://www.cdc.go.kr/board.es?mid=a20505000000&bid=0017&act=view&list_no=367190) and on June 6, 2020 (https://www.cdc.go.kr/board/board.es?mid=a20504000000&bid=0014&act=view&list_no=366585&tag=&nPage=1). USFDA EUA issuance info from USFDA.

Note: RdRP = RNA-dependent RNA polymerases, which catalyze the replication of RNA from an RNA template and are essential proteins encoded in the genomes of all RNA-containing viruses with no DNA stage⁷.

⁷ RNA-dependent RNA Polymerase, Viral Polymerases, 2019. <https://www.sciencedirect.com/topics/immunology-and-microbiology/rna-dependent-rna-polymerase>.

RT-PCR test-kits, the Korea Customs has streamlined and simplified the export process of these test-kits and the import of required test-kit ingredients from abroad.⁶⁰ The Korea Trade-Investment Promotion Agency (KOTRA) helps expedite the process from receiving deliveries from its 82 offices abroad across 57 countries.⁶¹ As of April

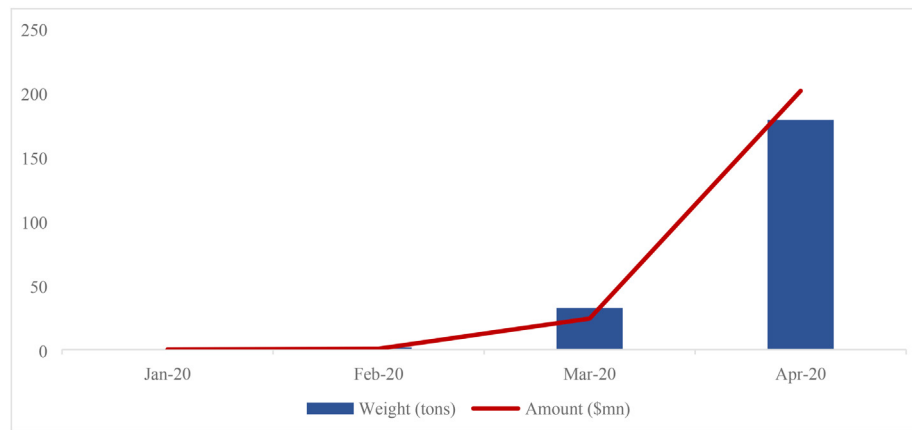
2020, South Korean RT-PCR test-kits have been exported to 103 countries worldwide.

4.3. Early response to COVID-19 by activating Large-Scale RT-PCR testing in South Korea

In an attempt to contain COVID-19, Moon’s government acted quickly to secure a large number of test-kits and make them accessible to the public. Data on testing statistics by country from ‘Our World in Data’ shows that testing in South Korea was at 0 on January 28, 2020, and started the following day at 0.001 tests per thousand people, i.e. 1 test a day. That number exponentially grew over the following days, doubling on February 6 and doubling again on February 8. By February 26 the number jumped to 0.1

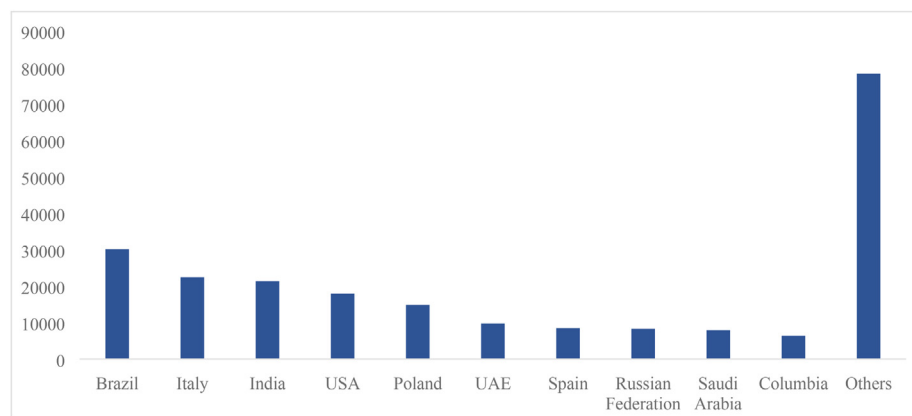
⁶⁰ Oh, Sang-hun and Woo-young Choi. ‘South Korean diagnostic kit exports total 4 million won → 280 billion won in three months... Customs Service “Never seen anything like this” (translated), Money Today, May 8, 2020. <https://news.mt.co.kr/mtview.php?no=2020050810142421746>.

⁶¹ Kim, Ji-eun. “‘Until we export diagnostic kits’...KOTRA to support local marketing for companies struggling with emergency entry restrictions” (translated), Newsis, May 11, 2020. https://newsis.com/view/?id=NISX20200511_0001020000&cid=13000.



Source: '한국산 코로나 진단키트 수출...103개국 2억6천만 달러(1~4월),' Korea Customs News, May 9, 2020. <http://www.kcnews.org/news/articleView.html?idxno=2646>

Fig. 3. PPP Implementation 2 in Early Response to COVID-19: Exports of Excess RT-PCR Test-Kits by South Korea from January to April 2020 (HS Code: 3822.00, Amount: Millions of USD, Weight Unit: Tons) Source: 'Exports of Made in Korea RT-PCR diagnostic test-kits for COVID-19: to 103 country destinations, totalling \$0.26 billion between January to April 2020 (Translated)', Korea Customs News, May 9, 2020. <http://www.kcnews.org/news/articleView.html?idxno=2646>.



Source: '한국산 코로나 진단키트 수출...103개국 2억6천만 달러(1~4월),' Korea Customs News, May 9, 2020. <http://www.kcnews.org/news/articleView.html?idxno=2646>

Fig. 4. PPP Implementation 2 in Early Response to COVID-19: Exports of Excess RT-PCR Test-Kits by Destination from January to April 2020 (HS Code: 3822.00, Amount: Thousands of USD) Source: 'Exports of Made in Korea RT-PCR diagnostic test-kits for COVID-19: to 103 country destinations, totalling \$0.26 billion between January to April 2020 (Translated)', Korea Customs News, May 9, 2020. <http://www.kcnews.org/news/articleView.html?idxno=2646>.

Table 3
South Korean RT-PCR Test-Kits issued EUA by USFDA (As of August 10, 2020).

Company	Date EUA Issued by USFDA	Product Name	Technology/Target Genes (RNA)	EUA Issued by KCDC/ MFDS
OSANG Healthcare	04/18/2020	GeneFinder COVID-19 Plus RealAmp Kit	Molecular (PCR)/RdRp, E, N	NA
Seegene, Inc.	04/21/2020	Allplex 2019-nCoV Assay	Molecular (PCR)/RdRp, E, N	Yes
SD Biosensor, Inc.	04/23/2020	STANDARD M nCoV Real-Time Detection Kit	Molecular (PCR)/RdRp, E	Yes
Seasun Biomaterials, Inc.	04/27/2020	1) U-TOP COVID-19 Detection Kit	1) Molecular (PCR)/Orf1ab, N	NA
	05/21/2020	2) AQ-TOP COVID-19 Rapid Detection Kit	2) Molecular (PCR)/Orf1ab	NA
LabGenomics	04/29/2020	LabGun COVID-19 RT-PCR Kit	Molecular (PCR)/RdRp, E	NA
1drop Inc.	05/11/2020	1copy COVID-19 qPCR Multi Kit	Molecular (PCR)/RdRp, E	NA
GeneMatrix, Inc.	05/14/2020	NeoPlex COVID-19 Detection Kit	Molecular (PCR)/unspecified	NA
Biocore	05/21/2020	BioCore 2019-nCoV Real Time PCR Kit	Molecular (PCR)/RdRp, N	Yes
SolGent Co., Ltd.	05/21/2020	DiaPlexQ Novel Coronavirus (2019-nCoV) Detection Kit	Molecular (PCR)/ORF1a, N	Yes
BioSewoom	07/09/2020	Real-Q 2019-nCoV Detection Kit	Molecular (PCR)/RdRp, E	Yes
Kogenebiotech	07/31/2020	PowerChek™ 2019-nCoV RTPCR Kit	Molecular (PCR)/RdRp, E	Yes

Source: Compiled from USFDA (as of August 10, 2020), company websites and South Korean news reports. <https://www.fda.gov/medical-devices/coronavirus-disease-2019-covid-19-emergency-use-authorizations-medical-devices/vitro-diagnostics-euas>.

Daily COVID-19 tests per thousand people

The figures are given as a rolling 7-day average.

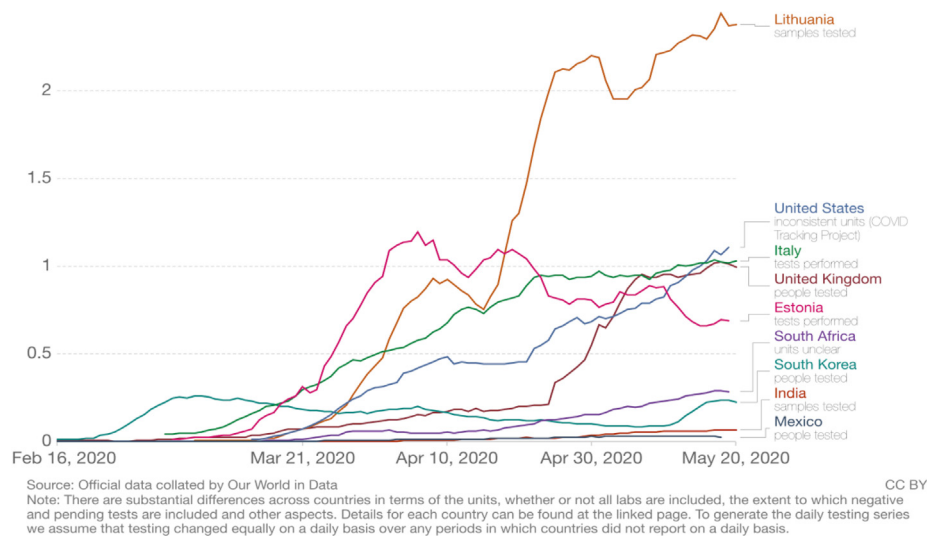


Fig. 5. COVID-19 testing in South Korea exceeded other countries in February and March 2020

Daily vs. total confirmed deaths due to COVID-19

Shown is the 7-day rolling average of confirmed COVID-19 deaths. Limited testing and challenges in the attribution of the cause of death means that the number of confirmed deaths may not be an accurate count of the true number of deaths from COVID-19.

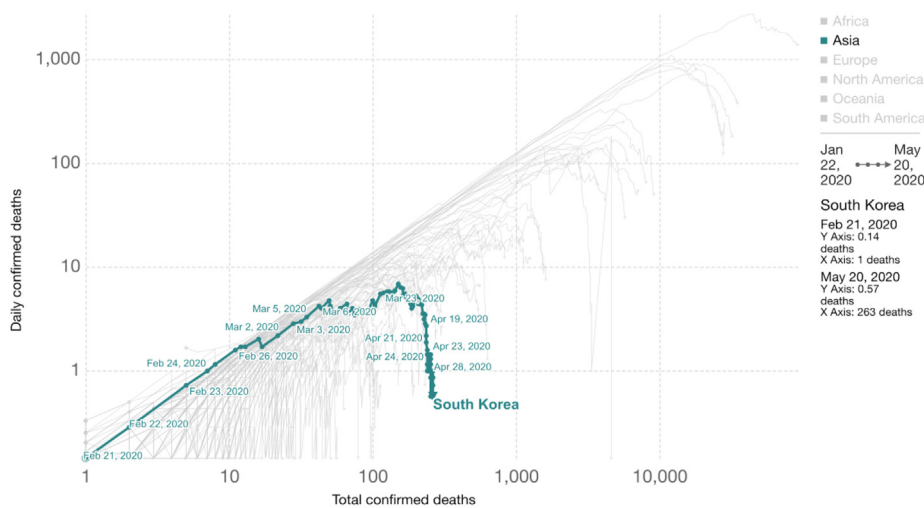


Fig. 6. Deaths from COVID-19 in South Korea drop in late March, and further decrease in April and May 2020

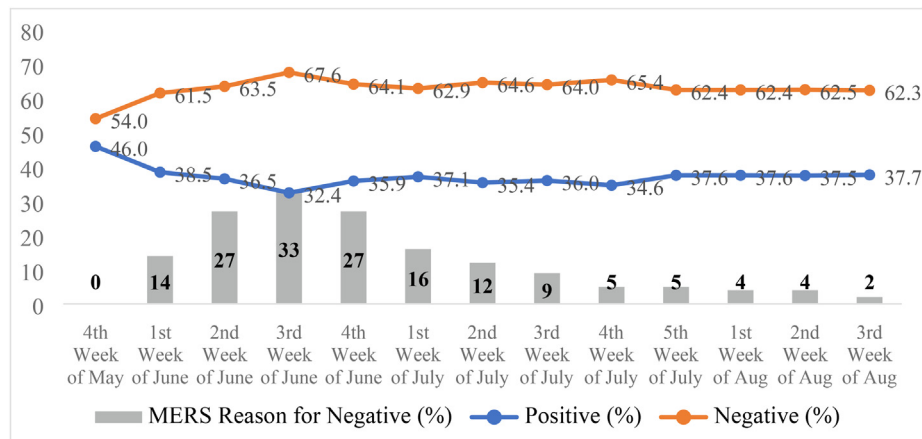
tests per thousand people, or 100 tests a day. The number of tests quickly exceeded 0.2, i.e. 200 daily tests, by March 1, and peaked at 261 tests a day on March 6, which was at the time the highest number of daily tests per thousand people in the world.

Fig. 5 clearly shows the increase in South Korea's number of tests in the initial stage of the outbreak, which soared earlier than any other country in February to mid-March. This swift response in the beginning stages of the pandemic most likely contributed to South Korea's success in flattening the curve earlier than other countries, which also enabled exports of excess test-kits around the world. Around the time of the testing peak on March 6, the number of deaths due to COVID-19 in South Korea started to stabilize. This development is depicted in Fig. 6. Figures in South Korea reached a plateau, and COVID-19-related deaths drastically dropped after March 23, continuing into April and May.

4.4. The impact of policy responses to pandemics on public opinion and political survival by incumbents

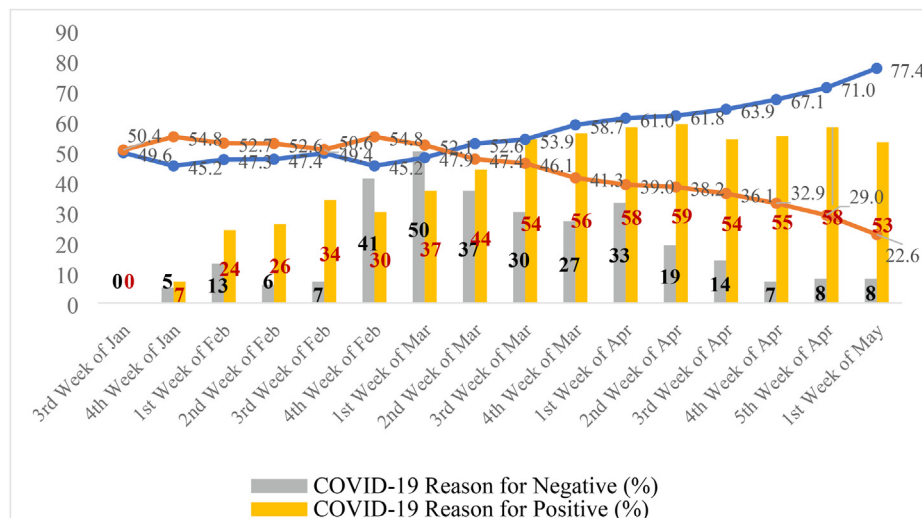
1) Political Performance in Time 1 and Time 2

Analysis of public evaluations of former president Park throughout the MERS outbreak and President Moon during the COVID-19 pandemic presents a number of indicators on how public support is affected by leaders' responses to pandemic situations: 1) policy neglect, or failure to swiftly and actively react to contain a pandemic, leads to a large drop in public support, and, conversely, 2) assertive policy action against a pandemic can cause a spike in public support. It can be assumed that the South Korean people's disappointment regarding Park's ineffective action to protect them from MERS raised public concern for safety and anxiety, eventually playing a role among other factors in Park's removal from power.



Source: Compiled and created based on Gallup Korea data (2015)

Fig. 7. Positive and negative public evaluations of President Park Geun-hye (Time 1), and percentage of respondents attributing to policy failure in MERS for negative evaluation Source: Compiled and created based on Gallup Korea data (2015)



Source: Compiled and created based on Gallup Korea data (2020)

Fig. 8. Positive and negative public evaluations of President Moon Jae-in (Time 2), and percentage of respondents attributing to policy response to COVID-19 for positive or negative evaluation Source: Compiled and created based on Gallup Korea data (2020)

On the other hand, the skyrocketing positive evaluations of Moon's policy response to COVID-19 in 2020 and his subsequent high support rating most likely contributed directly to the landslide victory of Moon's party in the general elections in April.

This section observes trends of the political consequences of disaster management by analyzing the rise and fall of public support for Park's and Moon's leadership during the MERS and COVID-19 outbreaks, respectively. Gallup Korea conducts weekly public opinion polls to assess the public's perception of the current president's governance as either positive or negative, as well as their main reasons for such evaluation. The survey questions used for this can be translated as: 1) "Would you evaluate the president as doing well or badly?" and 2) "What is the reason you think the president is doing well/badly?" (open response). The patterns of positive or negative evaluations of the president are visualized below in Figs. 7 and 8.

2) Park: Pandemic Governance Disappointment Affects Political Downturn

Above many markers of effective governance such as the economy, the South Korean public views protection of people's lives and public health as a critical policy priority. Fig. 2 shows the change of public support for Park during the MERS outbreak in 2015.

While Park's support rates were not very high just prior to the MERS outbreak, in the 4th week of May, it can be observed from Fig. 7 that positive evaluations of Park start plummeting as MERS spread in South Korea. In the 1st week of June, as MERS broke out, positive assessments of Park take a nosedive from 46% to 38%. After this drop, even at the final stages of MERS Park's positive evaluations do not recover to above 40% again.

Throughout the period of late May to late August, when MERS was most salient in Korea, Park's response to MERS was noted several times as the foremost reason for negative evaluations. In no week was MERS ever stated as a reason for positive evaluations of Park.

MERS first appeared in the polls as a reason for negative evaluations of Park in the 1st week of June, at 14%. The following week is

when MERS started appearing as the main reason for the public's negative appraisals of Park, with 27% of respondents pointing to Park's lack of action to battle MERS as the most important cause in their negative evaluations. It can be judged that the public viewed Park's MERS policies as most problematic, considering the second reason respondents gave most for negative evaluations ("No communication/not open to the public/not transparent") was only mentioned by 13%, or less than half of those who pointed to MERS. Moreover, this second reason referred more to a general attitude of Park's governance than her policies toward a direct incident. Thus, Park's inefficiency in coping with MERS was the dominant cause for growing public discontent.

Similarly, when MERS was mentioned as the biggest reason for a negative evaluation of Park at 33% in the 3rd week of June, the highest throughout the whole pandemic, the second most mentioned cause was only at 12% ("Dysfunctional state administration"), and the third was "Lack of leadership/avoidance of responsibility" at 12%. Both the second and third reasons hint at Park's attitude in governing the MERS situation rather than a separate event. In other words, MERS was the primary reason for the dissatisfied public.

As weeks went by and the threat of MERS gradually subsided, MERS was mentioned less as the prime reason for negative opinions of Park, yet public evaluations still did not recover to pre-MERS levels. The 4th week of June saw a slight recovery of positive support for Park, but the top reason for positive views of "hard-working (27%)" was vague, and the second biggest reason for negative views of Park was still attributed to "Lack of communication/not open to the public/not transparent," suggesting that the public had not changed their negative views of Park's MERS policies as a major problem.

In July MERS finally slid to 2nd place among the public's reasons for negative opinions of Park, but as can be observed in Fig. 7, support for Park still hovered around 35–37%. In the following weeks, even when respondents were ranking MERS as only the 3rd or lower cause for negative views of Park (from mid-July onward), support for Park only further diminished. In fact, even when MERS left the top ten list of reasons for negative opinion in the 3rd week of August—implying that the prominence of MERS had decreased—support for Park was at a mere 37.7%. This can be seen in the last data points on the far right of Fig. 7.

The official documents on the South Korean Constitutional Court's decision of Park's impeachment trial are publicly accessible. In the "2016 President (Park Geun-hye) impeachment decision" on March 10, 2017, page 59 of the 89-page document emphasizes the critical responsibility of the president to protect the lives and safety of citizens in a 'national crisis' situation, which includes natural and social disasters. Specifically, it reads:

"...if there is a possibility of serious harm to national sovereignty or the core elements or values of the state, such as the political, economic, social, and cultural systems constituting the state, the lives and safety of many citizens, or a 'national crisis' situation occurs, the President, the head of state, has a specific duty to protect the state and the people by taking timely measures in response to the state of crisis. These national crises include not only traditional security crises such as military threats, but also security crises caused by natural disasters, social disasters, and terrorism, and the latter is becoming more and more important in modern countries.

In such cases, when the president has been given a specific duty to serve, the president's duty to perform his duties is not merely a moral or political duty, but a legal duty, and its failure to comply is subject to judicial review. The duty of faithfully performing offices under Article 69 of the Constitution and the duty of faithfulness under Article 56 of the State Public Officials Act

becomes the norm for violating the Constitution or the law referred to in the grounds for impeachment when a specific duty to act is granted to the President."⁶²

The fact that this point is highlighted in the impeachment decision indicates that Park's handling of national crises was a major contributing factor that led to her impeachment. Furthermore, it can be inferred that Park's misgovernment of MERS was what the Constitutional Court was mainly alluding to, as it was specified in the decision that the Sewol Ferry Disaster was not a direct cause of impeachment. The decision specifies that:

"Article 65 (1) of the Constitution restricts the grounds for impeachment to 'violation of the Constitution or law,' and the impeachment trial procedure of the Constitutional Court only judges the existence or absence of grounds for impeachment from a legal point of view. Whether or not the respondent faithfully fulfilled her position on the day of the Sewol ferry disaster, as claimed, cannot be a reason for prosecution in itself, and is not subject to judgment in the impeachment trial procedure."

In sum, it can be inferred that MERS was indeed one of the main causes of Park's impeachment. In the decision for impeachment, the constitutional court stated that it is the legal duty of the president to take action in a disaster situation, and foregoing the legal duty is deemed unconstitutional. While both the Sewol incident and MERS were primary examples of Park's failure to govern a national disaster situation, both of which contributed to diminishing public support toward Park, the constitutional court specified that in terms of direct causes for impeachment at least from a legal perspective, the Sewol incident was not included. Therefore, although the Constitutional Court did not specifically mention the term "MERS" in their decision, it can be presumed that mismanagement of MERS was one of the major causes of Park's impeachment, albeit indirect.

3) Moon: Pandemic Governance Results Salvages Incumbency

A couple of years in, Moon's government was suffering from low support rates due to public fatigue of his foreign policy vis-a-vis North Korea and economic downturn.⁶³ Moon had positioned himself as more pro-North Korea and closer to China than his predecessor, while taking a stronger stance against the U.S. and Japan, compared to many earlier South Korean leaders who represented the more conservative party. In the wake of COVID-19, Moon had run out of political capital prior to a general election and deemed it absolutely crucial to efficiently and effectively contain the pandemic in order to sustain his leadership. Learning from past criticism

⁶² Constitutional Court Decision, Case 2016 Impeachment of President (Park Geun-hye). Claimant: National Assembly, Prosecution Committee Chairman of the National Assembly Legislative Judicial Committee. Respondent: President Park Geun-hye. Date of sentence: 2017. 3. 10. 11:21 Order: Respondent President Park Geun-hye is dismissed. https://www.lawtimes.co.kr/data/file/article-attached/article-108620.pdf?fbclid=IwAR2NwF3S74XayRK0UqoMXXReW_y0nSBHbLgJkKi3nSzY-QI1gkFlplpry14.

⁶³ Public opinion polls reveal caution and unease toward Moon's drive and willingness to strengthen inter-Korean cooperation through family reunions, the establishment of inter-Korean liaison offices in the Kaesong Industrial Complex, and railroad connections. In a 2018 poll conducted by Hankook Research, 36% of participants responded that the national economy will worsen if aid is given to North Korea in full scale, with just 27% responding that the national economy will improve. Regarding the impact of aid to North Korea on the domestic economy, 27% answered that it would worsen the domestic economy while only 10% said aid would improve it. See Jeong, Hanul, "Perceptions of Security vis-à-vis North Korea after the US-North Korea Summit," Hankook Research. September 20, 2018 (<https://hrcopinon.co.kr/archives/11783>). These views represent the controversy and public concern that Moon's unilateral aid to North Korea will negatively impact national security and the economy. Moon has consistently emphasized the importance of cooperation with North Korea, as is observable from his official policy keynotes published by the President's Office, which includes "Inter-Korean relations: Peace on the Korean Peninsula is the path we must pursue" (President's Office 2020).

on Park regarding the absence of an effective control tower in the MERS outbreak, Moon's party fully delegated the role of control tower to MOHW and KCDC to handle COVID-19. In addition, in order to break from Park's precedence, Moon took a hands-on approach, swiftly signing presidential decrees to be passed via fast-track in the National Assembly to enable widespread testing and sufficient supply of medical.⁶⁴

In contrast to Park's response to MERS, Moon's COVID-19 policies have generally been viewed as a success. Ultimately, an overwhelmingly positive public opinion of Moon led to a victory for his Democratic Party in the general elections on April 15, 2020. Voter turnout rates hit a rare high at 66.2%, 8.2 percent points higher than the previous legislative election, and the Democratic Party and its satellite, the Platform Party, together took 180 of 300 seats (60%), the highest number by any party since 1960.⁶⁵

As Policy Feedback theorists would predict, the South Korean public's perceived success of Moon's COVID-19 policies reshaped the political environment. The landslide victory of Moon's party allows the liberal alliance an absolute majority in the legislative chamber. In addition, three-fifths super-majority was achieved by the liberal parties, which is required to fast-track procedures. On the other hand, the conservative party alliance between the United Future Party and its satellite Future Korea Party won only 103 seats,⁶⁶ the lowest result for conservative parties since 1960.

4.4.1. Public opinion data: Gallup Korea

As can be seen in Fig. 8, when COVID-19 first hit South Korea in mid-January, the public's view of Moon was evenly split, with slightly more people holding negative views of him (50.4%) than positive views (49.6%). This occurred when support for Moon's government was slipping due to the fear Moon's pro-North Korean foreign policy was causing for some older generations in South Korea with conservative views on security issues. In the Gallup Korea weekly opinion polls for the 4th week of January, COVID-19 was first mentioned as a cause for opinions for or against Moon. Seven percent of respondents noted Moon's coping with COVID-19 as a main reason for support for Moon, whereas 5% stated it was a reason for negative views against Moon. In contrast to Park's case in 2015, where her dealing of MERS was only noted as a reason for negative opinion and never for positive, in the 2020 polls for Moon, his COVID-19 policies were mentioned as both a reason for positive (indicated in yellow bars in Fig. 8) and negative evaluations of him (indicated in gray bars in Fig. 8). It is noteworthy, however, that from March to May, Moon's handling of COVID-19 is mentioned as the primary cause for support, to the extent that in May a massive 53% of respondents note it as a reason for positive evaluations, whereas only 8% say it is a reason for their negative views of him.

Even after the salience of COVID-19 started to decline, the public's positive views of Moon remained high. This occurred when several international media sources were complimenting South Korea's early response as a general success, and when the virus was considered more or less contained domestically, evidenced by the steadily declining number of confirmed cases and deaths related to COVID-19. More specifically, just a week after COVID-19 first appeared in the polls, by the 1st week of February Moon's COVID-19 policies were ranked as the biggest reason for positive views of Moon, and stayed in the 1st rank for 10 weeks until the

2nd week of April. By the 1st week of May COVID-19 was ranked at only the 4th biggest reason to support Moon, but this was in fact when support for Moon had peaked, with a substantial 77.4% evaluating Moon positively, and just 22.6% rating him negatively.

4.4.2. Moon's public speeches during the COVID-19 pandemic

An analysis of Moon's public speeches adds further evidence that Moon held the lessons of the past in mind. We examine 76 official presidential speeches listed on the Blue House website from January 30, when Moon made his first speech that mentioned COVID-19, to May 8, which is the latest record available. Our sources were "Moon Jae-in's speech collection," Volume 2, which covers November 1, 2019, to May 9, 2020, "Chief and Aide Conference of the State Council," Book 3, May 10, 2019, to May 9, 2020, and "President Moon Jae-in's Speeches and Writings: Definite change with the people," Volume 3, all published by the President's Office and publicly accessible online.

Out of the 76 speeches, 36 are listed specifically to be "COVID-19-related" speeches. This means that 47% of the speeches Moon gave in that period were classified separately as being on the topic of COVID-19. This points to the significance Moon's government assigned the issue. In particular, in the 30 days leading to the April 15 general elections, Moon gave 14 COVID-19 related speeches, an average of 1 speech every 2 days.

A word frequency analysis provides that Moon mentioned the term "Corona"⁶⁷ 242 times in all of his speeches combined during this period, indicating his focus on the issue. Even in Moon's speeches on other topics from February to May 8, Moon mentioned "Corona" 11 times across his 40 non-COVID-19-related speeches, suggesting Moon's sense of priority and perceived urgency of COVID-19.⁶⁸ More importantly, Moon often referred to MERS to contrast it with COVID-19 and highlight the lessons learned from it. Moon differentiated the current situation from MERS by mentioning it at least 7 times in his speeches. Although this is a lower frequency than mention of COVID-19 itself, the point of focus is that Moon often invoked this earlier case of MERS as a reminder of how far South Korea had come in fighting diseases, and how different the governmental response was this time around.⁶⁹ The following excerpts from Moon's speeches introduce MERS as a point of comparison to the current COVID-19 situation, and also highlight the importance of PPPs to fight the pandemic more effectively.

"We have already confirmed that our quarantine and health and medical systems are world-class. This is the result of our development in the response system by taking advantage of the experiences of SARS and MERS. ... We will strengthen the expertise and

⁶⁷ The common Korean translation of COVID-19 is "Corona"; the exact term COVID-19 is rarely used to refer to the virus.

⁶⁸ These were Moon's speeches at the Ministry of Strategy and Finance, Ministry of Trade, Industry and Energy, Ministry of SMEs and Startups, Finance Committee Report on February 17, 2020, the Ministry of Land, Infrastructure, Transport and Maritime Affairs and Fisheries Business Report, February 27, 2020, the Ceremony for the 101st anniversary of March 1st (where Moon referred to COVID-19 6 times), the 72nd Anniversary Jeju 4/3 Victims' Memorial Ceremony, April 3, 2020, the 60th Anniversary April 19th Revolution Ceremony, April 19, 2020, and the World's Largest Container Ship Ceremony, April 23, 2020.

⁶⁹ In comparison, Severe Acute Respiratory Syndrome (SARS) was only mentioned twice. Considering that SARS was an issue in South Korea in 2003, which had been 3 presidencies ago, lessons from SARS would presumably have an indirect effect compared to MERS. Moon was the president directly borne out of Park's failed leadership, one of the main causes being Park's neglect to manage MERS early, among others. In addition, the president at the time of SARS (Rho Moo Hyun) was generally considered to have done an effective job in containing SARS (there were no domestic deaths and only 3 infected from SARS) and ideologically closer to Moon than Park, so less was to be noted from the SARS case in terms of the possible political downturn following failure in pandemic governance compared to Park's governance of MERS (Yeom 2020).

⁶⁴ Kim, Juni. 'Moon Jae-in's Approval Rating Soars on COVID-19 Response,' The Peninsula, Korea Economic Institute of America, May 14, 2020. <http://blog.keia.org/2020/05/moon-jae-ins-approval-rating-soars-covid-19-response/>

⁶⁵ 'South Korea's governing party wins election by a landslide,' Al Jazeera, April 15, 2020. <https://www.aljazeera.com/news/2020/04/south-korea-ruling-party-wins-election-landslide-200416000355845.html>

⁶⁶ Ser, Myo-Ja, 'Moon's Ruling DP wins landslide in legislative polls,' Korea JoongAng Daily, April 16, 2020. <https://koreajoongangdaily.joins.com/news/article/article.aspx?aid=3076179>

independence by promoting the Center for Disease Control and Prevention to the Agency for Disease Control and Prevention."

-Moon Jae-in's Special speech for the 3rd anniversary of inauguration, May 10, 2020 (*Definite change with the people*, Vol. 3, President's Office).

"Although we have less resources and less experience in drug development than global pharmaceutical companies or developed countries, we have been working on technology development by taking into consideration the difficulties of the MERS infection in 2015. We look forward to being able to save human life with our treatments and vaccines, as we have worked hard before others to become the world's model with diagnostic technology. The government's R&D investment and the approval process will need to be supported to accelerate the development of COVID-19 treatment and vaccines."

-Joint meeting of industries, academia, research institutes, and hospitals for COVID-19 treatment and vaccine development, April 9, 2020.

Even before COVID-19, at lower points of public support Moon reminded citizens of MERS to differentiate his government's crisis management approaches from Park's. In Moon's speech at the Eulji Taegeuk State Council and 21st State Council (May 29, 2019), he emphasized that since its launch, his administration's ability to respond to individual disasters improved significantly, as confirmed by the Pohang earthquake, bird flu and foot and mouth disease, MERS, and forest fires in Gangwon-province. "Now, we want to go one step further and increase the national disaster management system and response capabilities to deal with large-scale complex disasters that occur in series. I hope that this exercise will strengthen the country's crisis management capabilities and fulfill the nation's responsibility to protect national safety" (Chief and Aide Conference of the State Council May 10, 2019–May 5, 2020, Book 3).

To contrast himself with Park, who was criticized for her slow response to MERS, reducing or denying the scope of the pandemic as a threat, Moon frequently emphasized a "speedy" response as crucial in fighting COVID-19. Across Moon's speeches from February 1 to May 8, 2020, the word "speed" appeared 13 times, and both "urgent/emergency" and "quickly" each appeared 25, times with regard to response to COVID-19. The words "quick" and "quickness" were mentioned 12 and 36 times, respectively. Examples that highlight Moon's emphasis for a speedy response in his speeches are provided below.

The central government, local governments, people and governments cooperate, and they are all working together. The problem is time and speed.

- [COVID-19-Related Speech] Daegu area Special countermeasure meeting, February 25, 2020

In addition to urgent countermeasures, we hope that you will be interested in your mid- to long-term countermeasures and gather wisdom. . . . We will promptly execute emergency budgets including special grant taxes and reserves, and seek strong support measures that go beyond proclaiming special disaster areas. . . . In order to fully support various necessary supports with a budget, an emergency supplementary budget will be prepared and submitted to the National Assembly as soon as possible.

Speed is the key. During the 2015 MERS Situation, I first proposed an additional economic budget as the opposition leader to pass it quickly. As it is an emergency, we would like to discuss it promptly and take care of it at this temporary session.

- [COVID-19-Related Speech] Dialogue with representatives of the opposition parties, February 28, 2020

In addition to strengthening the ability to respond to infectious diseases, we will accelerate economic stability Above all, we will

try to ensure that the necessary support is reached in a timely manner by prompt execution.

- [COVID-19-Related Speech] Major Economics Units Roundtable, March 18, 2020

First of all, we will urgently create a key industry stabilization fund for overcoming the crisis and employment at a scale of 40 trillion won. Again and again, the most important thing is speed.

- [COVID-19-Related Speech] The 5th Emergency Economic Conference, April 22, 2020

Moon's publicly stated goals of national governance suggest that his overall approach is to clearly distinguish his government from Park's. The Blue House lists Moon's "five goals of national government," each of which has 4 sub-categories, leading to 20 "national political strategies." The terms used in these goals and strategies are opposite to common descriptions of Park's ruling style. The first of the five goals are "a government of the people." The four strategies included in this goal use words that emphasize differentiation and improvement from the past: "1. Realization of candlelight democracy and sovereignty of citizens, 2. A Gwanghwamun (the symbolic square in central Seoul between the Seoul City Hall and the Blue House where most of the candlelight vigils and protests against Park took place) president that integrates through communication, 3. Transparent and competent government, and 4. Democratic reform of powerful institutions" (President Moon Jae-in's speech collection Volume 23 (2) November 1, 2019 to May 9, 2020. Appendix, "Moon Jae-in government's national vision: 5 National Goals and 20 National Strategies," President's Office).

Park's government has been described as generally "veiled" compared to Moon's, with far fewer public speeches and little emphasis on transparent communication. Relatedly, there are no governmental sources of Park's speeches released to the public, but internet archives of the few speeches Park delivered during her cut-short term reveal that the 11 speeches she gave from the May 2015 outbreak of MERS in Korea to the end of her term include 0 mentions of MERS. Commentators have criticized Park for concealing the scope of MERS infections and underplaying its significance.

Taken together, our analyses suggest that in a democratic system whereby leadership is constantly questioned by the public, pandemic governance results may impact the life expectancy of political leaderships for better or worse. As the cycle of outbreaks become shorter and second waves of COVID-19 occur in unexpected time frames, political leaderships in democratic societies risk being tossed out of office if they do not deliver on pandemic governance.

5. Conclusion

5.1. Significance of Institutional Changes between Time 1 and Time 2

To enhance promptness and efficiency in pandemic governance and to deliver an early response, the perusal of institutions that were changed between Time 1 and Time 2 to outpace the spread of COVID-19 was essential. The activation of PPP on EUA by KCDC and MFDS to enable large-scale RT-PCR testing nationwide as early as possible in South Korea and the delegation of power in pandemic governance to the specialists (MOHW and KCDC) to act as control tower were means to Moon's end of urgently containing the virus when pressured by the petitions for impeachment in the run-up to the general election date to secure incumbency. We argue that such reasoning and action by Moon (Time 2) can be viewed as a result of policy feedback and learning from the precedent of Park's unsuccessful governance (Time 1).

5.2. Policy implications

Our analysis suggests that leaderships must be institutionally prepared by change and open to PPP for better pandemic governance. In order to do so, in the context of policy feedback, substantial institutional changes must be made after Time 1, while incorporating transparency by installing a clear and present control tower of competent public health authorities. Such policy moves assure the public that science is not overridden by politics even when there are political motivations by the leadership in the background. It also reveals that voluntary civic participation in large-scale RT-PCR testing and mask-wearing as well as democratic checks-and-balances of the government are crucial to flatten the curve, and that pandemics can turn into opportunities for innovation ripe with R&D (Oh et al., 2020). However, there is room for progress for the IVD industry in South Korea, and in the future it should develop and manufacture the ingredients for reagents domestically to ensure a seamless domestic production process and guarantee supply.⁷⁰ Ensuring quality and accuracy of the test-kits is critical not only for flattening the curve, but also for positive responses and continued growth.⁷¹

5.3. Limitations

Difficulty may arise in application of our conceptual framework to non-democratic governments, or states where a pharmaceutical industry is either nonexistent or so strong that it can override the government's initiatives. Ideally, pharmaceutical industries must be robust enough to serve as a platform for fast-tracked measures by the government to swiftly act against pandemics. Similarly, PPP may be less efficient or less successful in cases where the private sector could overpower the public realm, and thus public and private sectors must be open to collaboration. Additionally, the citizenry by a social consensus must be willing to participate in government initiatives in large-scale testing for such policies to be effective.

The currency of COVID-19 presents some uncertainty in the evaluation of governmental effectiveness and political consequences that might follow. The timeframe of this project spans up to May 2020. Although Moon's political party may have been successful in the legislative elections of April 2020 largely due to the public's satisfaction regarding Moon's handling of COVID-19, it remains to be seen how he and his party will be evaluated in the long term in the run-up to the 2022 Presidential election. While the COVID-19 pandemic situation is not completely over in South Korea or in any other part of the world, our analysis has concentrated on South Korea's early response to COVID-19 and the South Korean public's perception of Moon's governance to date. The fact that unprecedented pursuit of South Korean RT-PCR test-kits by some 103 countries reveals that large-scale testing is becoming a choice for countries around the world to fight COVID-19. The applicability of our conceptual framework based on South Korea's early response to COVID-19 would be viable for countries that have democratic leaderships with checks-and-balances on government performance, capable public health authorities, and a pharmaceutical industry with a possible citizenry participation in large-scale testing.

⁷⁰ Kim, Byung-ho, 'K-kit status raised, but... useless if Roche doesn't provide reagents' (translated), MK News, May 12, 2020. <https://www.mk.co.kr/news/it/view/2020/05/485091/>.

⁷¹ Liu, Roxanne and Alexandra Harney, 'China clamps down on coronavirus test kit exports after accuracy questioned', Reuters, April 1, 2020. <https://uk.reuters.com/article/us-health-coronavirus-china-testkits/china-clamps-down-on-coronavirus-test-kit-exports-after-accuracy-questioned-idUKKBN21J51S>.

Many democracies are grappling with COVID-19 in an unexpected manner. Among them, of particular concern is the performance in pandemic governance by major democracies such as the U.S., Brazil and India (The Lancet, 2020), where the pandemic continues to extract a major toll amid insufficient government efforts. Their lackluster performance on tackling COVID-19 cast doubts on whether they would respond differently in future pandemics. The common denominators in their performance include politics overriding science in the absence of transparency, the blurred presence of health authorities that can serve as a clear and present control tower and overwhelming populism (McKee, Gugushvili, Koltai, & Stuckler, 2020).

In the U.S., the role of the CDC and the health authorities led by Dr. Anthony Fauci were often undermined by political elites, and the president continued to appear in the briefings although he himself was not an expert of the pandemic situation nor the virus itself. In India, where the healthcare system is in development, extensive lockdown and curfews were implemented to control the virus (Paital et al., 2020; Chaurasiya et al., 2020) amid rising anxieties (Roy et al., 2020; Das & Dutta, 2020). Amid criticisms on transparency of the COVID-19 fund, although Indian Prime Minister Narendra Modi has come to stress the need for increased testing⁷², he has not stepped aside for the India Centers for Disease Control (ICDC) to act as control tower and has remained in the spotlight.⁷³ In Brazil, President Jair Bolsonaro's speech in Miami in March 2020 disinforming the public on COVID-19 (Barberia and Gómez, 2020) and led them to discredit the lethal power of the virus (Tavares, de Oliveira Júnior, & Magalhães, 2020), himself getting affected by COVID-19. Brazil's Centers for Disease Control and Prevention (CDC) was not a clear control tower in controlling COVID-19, and non-pharmaceutical interventions such as social distancing and contact tracing (Pei et al., 2020) by the Brazilian government fell short of implementation (Candido et al., 2020), causing mobility to further mutate the virus in different forms (Baqui et al., 2020). Similar policy missteps in lack of transparency and unclear policy guidance were witnessed in the democratic governments of the United Kingdom and Japan.

In order for the current democratic governments' experience of COVID-19 to feed back into future pandemic governance as a result of policy learning in Time 2, governments must be willing to provide transparency and deliver clear guidelines based on science. Mistakes can be made in Time 1, but only by acknowledging the missteps and changing the approach toward efficient and transparent pandemic governance based on science would enable policy learning feedback.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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⁷² 'PM Modi urges states to ramp up testing, says their role is crucial in Covid-19 fight,' Hindustan Times, August 11, 2020. <https://www.hindustantimes.com/india-news/pm-modi-urges-states-to-ramp-up-testing-says-their-role-is-crucial-in-fight-against-covid-19/story-JWgEi35IzZ30WSjgvsBtl.html>

⁷³ 'Coronavirus: Secrecy surrounds India PM Narendra Modi's '\$1bn' Covid-19 fund,' BBC, June 30, 2020. <https://www.bbc.com/news/world-asia-india-53151308>

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